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THE

CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE.

(WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE.")

A Journal of Practical Chemistry

IN ALL ITS APPLICATIONS TO

PHARMACY, ARTS, AND MANUFACTURES.

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WILLIAM CROOKES, F.R.S., &c.

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THE CHEMICAL NEWS.

VOLUME XXV.

EDITED BY WILLIAM CROOKES, F.R.S., &c.

No. 632.—FRIDAY, JANUARY 5, 1872.

CONTRIBUTIONS TO THE HISTORY OF ORCIN.

No. II. Chlorine- and Bromine-Substitution Compounds of the Orcins.*

By JOHN STENHOUSE, LL.D., F.R.S, &c.

Schunck,† and subsequently the author of this paper,‡ many years ago studied the action of chlorine upon orcin, and obtained more or less crystalline products, contaminated with a brown resinous matter, from which, however, they did not succeed in separating the crystals in a state of purity. In the year 1864 De Luynes§ obtained a crystalline substance by acting on orcin with a mixture of potassium chlorate and hydrochloric acid. De Luynes states it to be trichlororcine, $C_7H_5Cl_3O_2$, and in Kekulé's "Benzolderivate" the melting-point is given at 159°.

Chlororcin.

Pentachlororcin, $C_7H_3Cl_5O_2$.—This compound was obtained by the action of chlorine upon orcin when the former was kept in excess. Two methods of effecting this object were employed, the first by adding the orcin to chlorine hydrate, the other by the action of potassium chlorate and hydrochloric acid..

A pulpy mixture of the crystalline hydrate of chlorine and water was first prepared by passing a current of chlorine with occasional agitation through water, to which about one-third of crushed ice had been added, until a sufficient quantity of the hydrate was formed. On gradually adding a moderately strong aqueous solution of orcin, a purple colour was produced when the solution first came in contact with the chlorine hydrate, but disappeared immediately on agitation. The addition of the orcin was continued until nearly all the chlorine hydrate was decomposed. It was always advisable to leave a slight excess of the latter, as a purer product was then obtained, and also to have some crushed ice present in the mixture, to avoid decomposition and consequent loss of the hydrate by the heat produced during the reaction. The colourless or pale yellow solution, on standing, yielded a crystalline deposit of crude pentachlororcin.

After many trials, however, it was found that pentachlororcin could generally be more conveniently prepared in quantity by submitting orcin to the chlorinating action of a mixture of hydrochloric acid and potassium chlorate in the following manner:—Four parts of powdered potassium chlorate and a solution of two parts of orcin in seven parts of hydrochloric acid were added to thirty-five parts of hydrochloric acid, sp. gr. 1·17, placed in a large beaker, and kept cool by immersion in water; a small portion of the potassium chlorate was first added to the hydrochloric acid in the beaker; on pouring in some of the solution of orcin, the same evanescent purple colour made its appearance as when chlorine hydrate was used; the alternate addition of the chlorate and the orcin solution was continued in such a manner that there might always be an excess of chlorate, and that the contents of the beaker never became very hot. It was found necessary to use concentrated hydrochloric acid in this experiment, as otherwise the product was largely contaminated with a viscid oily compound. After twelve to twenty hours the crystalline chlororcin was collected and washed with a small quantity of water. Orcin treated with chlorine hydrate yields nearly twice its weight of crude chlororcine, but with potassium chlorate and hydrochloric acid about 150 per cent of its weight.

In order to purify the crude chlororcin obtained by either of the above-described methods, it was dissolved when dry in a considerable quantity of carbon disulphide (eight measures), filtered, and concentrated by distillation (to one-half). On being set aside for some time it usually crystallised out; but as it exhibits strongly the phenomenon of supersaturation, especially when impure, it was sometimes necessary to agitate or add a crystal of the substance. The solution then immediately deposited the chlororcine, and occasionally became hot enough to cause ebullition of the carbon disulphide. Two or three crystallisations rendered it quite pure. Pentachlororcin crystallises from carbon disulphide in large colourless prisms, melting at 120·5°. It is moderately soluble in bisulphide of carbon and benzol, and readily in ether. It dissolves somewhat in cold alcohol, and when boiled with it for some time undergoes a change which I have not as yet investigated—water throwing down an oil which only solidifies after having been exposed to the air for some days in a shallow vessel. The pentachlororcin is but very slightly soluble in water, to which, however, it communicates an exceedingly disagreeable and persistent bitter metallic flavour. When boiled with water it is decomposed, an oil and a crystalline solid passing over with the vapour. The oil, which has a peculiar odour, recalling that of chloropicrin, is heavier than water; the solid compound crystallises in needles, and is identical with the trichlororcin described below. When heated with concentrated sulphuric acid it blackens and decomposes, giving off hydrochloric acid. It dissolves in nitric acid by the aid of heat, and crystallises out unchanged on cooling. The addition of water to the solution precipitates the pentachlororcin. By long boiling with the acid it is decomposed with evolution of nitrous fumes.

Analysis of Pentachlororcin.

I. 0·901 grm. substance gave 0·937 grm. carbonic anhydride and 0·096 grm. of water.

II. 0·196 grm. substance gave 0·473 grm. argentic chloride.

III. 0·360 grm. substance gave 0·871 grm. argentic chloride.

IV. 0·229 grm. substance gave 0·555 grm. argentic chloride.

V. 0·202 grm. substance gave 0·488 grm. argentic chloride.

* Read before the Royal Society. A Preliminary Notice of several of the compounds described in this paper appeared in the Chemical News, vol. xxiii. p. 230, and *Zeits. Chem.*, vol. vii., p. 229.

† *Ann. Chem. Pharm.*, vol. liv., p. 271.

‡ *Phil. Trans.*, 1848, p. 88, and *Ann. Chem. Pharm.*, vol. lxvii., p. 97.

§ *Ann. Chem. Pharm.*, vol. cxxx., p. 34; Kekulé's "Benzolderivate," vol. i., p. 338.

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Theory.		I.	II.	III.	IV.	V.	Mean.
C_7 = 84·0 = 28·33		28·36	—	—	—	—	28·36
H_3 = 3·0 = 1·01		1·18	—	—	—	—	1·18
Cl_5 = 177·5 = 59·87		—	59·70	59·85	59·96	59·75	59·82
O_2 = 32·0 = 10·79		—	—	—	—	—	—
	296·5						

V. was prepared by the action of potassium chlorate and hydrochloric acid; I., II., III., and IV. by means of chlorine hydrate. The substance was dried *in vacuo*.

Terchlororcin, $C_7H_5Cl_3O_2$.—When pentachlororcin was heated with hydriodic acid to 100° it was decomposed, terchlororcin being formed and iodine set free. The best method of conducting the operation, so as to obtain a pure product, was to add the pentachlororcin in small portions to a mixture of amorphous phosphorus and hydriodic acid, containing 8 or 10 per cent of iodine, and to digest between each addition until the liberated iodine had been re-converted into hydriodic acid. When all the pentachlororcin had been introduced, the digestion was continued until the trichlororcin appeared as a colourless oily layer at the bottom of the flask. On cooling, a considerable portion more crystallised out of the hydriodic acid in colourless needles. The oily trichlororcin, which solidified on cooling, was dissolved in a small quantity of spirit, filtered to separate it from the excess of amorphous phosphorus, and the alcoholic solution precipitated by water. The amount of crude product thus obtained was about 75 per cent of the weight of the pentachlororcin originally employed. One or two crystallisations from boiling water slightly acidified with acetic acid rendered it quite pure. If very pure pentachlororcin had not been employed in the preparation the crude product was more or less coloured, and could only be purified with considerable difficulty, as the colouring-matter adheres to the trichlororcin with great obstinacy. It was found, however, that several alternate crystallisations from benzol and petroleum oil, and a final crystallisation from water, almost entirely removed the brown colouring matter. It fuses to an oil under boiling water, in which it is moderately soluble, crystallising out almost completely on cooling in long colourless transparent needles, which become white and opaque when exposed to the air. It is but sparingly soluble in carbon disulphide, moderately in petroleum oil, rather more so in benzol, and excessively soluble in ether and alcohol. It is soluble in boiling glacial acetic acid, and crystallises out on cooling in thin transparent plates, which become white and opaque on the addition of water. Trichlororcin melts at 123°, and when heated to a very much higher temperature it blackens and gives off hydrochloric acid, even under diminished pressure. It cannot, therefore, be distilled *in vacuo*, but it passes over readily with the vapour of water. When heated for several hours to 180° with moderately strong hydriodic acid and phosphorus, it was found to be re-converted into orcin, which could be extracted from the solution by agitating it with ether. The addition of alcoholic ammonia to a solution of the trichlororcin in alcohol threw down a white crystalline precipitate, but slightly soluble in water or alcohol. This compound, when dissolved in a large excess of dilute aqueous ammonia, and submitted to the action of metallic zinc in a close vessel at the ordinary temperature, yielded a colourless solution. On exposing this to the air, however, it acquired a fine blue colour, which was changed to red by the action of acids. Further investigation will no doubt show the nature of this compound.

Analysis of Trichlororcin.

I. 0·257 grm. substance gave 0·486 grm. argentic chloride.

II. 0·302 grm. substance gave 0·572 grm. argentic chloride.

III. 0·216 grm. substance gave 0·293 grm. carbonic anhydride and 0·046 grm water.

Theory.		I.	II.	III.	Mean.
C_7 = 84·0 = 36·93		—	—	37·00	37·00
H_5 = 5·0 = 2·20		—	—	2·37	2·37
Cl_3 = 106·5 = 46·81		46·78	46·86	—	46·82
O_2 = 32·0 = 14·06		—	—	—	—
	227·5 100·00				

I. was from the pentachlororcin prepared by the action of chlorine hydrate on orcin; II. and III. from that prepared by hydrochloric acid and potassium chlorate. The substance was dried *in vacuo*.

This trichlororcin differs considerably in its melting-point and other properties from that described by De Luynes* as formed by the action of hydrochloric acid and potassium chlorate on orcin. Moreover, although many attempts were made to prepare trichlororcin by his method with varying proportions of the materials, pentachlororcin was invariably obtained, contaminated, however, in some instances, with a large amount of viscid oily impurities. I conclude, therefore, that De Luynes's trichlororcin was either isomeric with that above described or that it was an impure substance.

Bromorcin.

Pentabromorcin, $C_7H_3Br_5O_2$.—This compound was readily formed by the action of an excess of bromine on orcin. Seven parts of bromine and about 200 of water were placed in a stoppered bottle, and a moderately strong aqueous solution of one part of orcin added by small portions, with constant agitation. The yellow crystalline product thus obtained, amounting to 370 per cent of the weight of the orcin, was then collected, and purified by repeated crystallisation from carbon disulphide, in a manner similar to the corresponding chlorine compound. It is almost insoluble in water, very soluble in alcohol and ether, and moderately so in benzol and carbon disulphide, from the latter of which it may be obtained in very large and almost colourless transparent crystals. It melts at 126°, and when boiled with water appears to undergo a decomposition similar to the pentachlororcin. Heated with concentrated sulphuric acid it gradually dissolves, and on continuing the heat hydrobromic acid and bromine are evolved in abundance. Like the corresponding chlorine compound, it dissolves in hot nitric acid, crystallising out again on cooling, but is at the same time far more readily decomposed. When boiled with amorphous phosphorus and moderately strong hydriodic acid it is rapidly decomposed, and passes into solution probably as orcin. With very weak hydriodic acid, however, containing about one per cent of iodine and excess of amorphous phosphorus, the decomposition takes place more gradually, and a heavy oily layer is obtained, which solidifies on cooling. This, after purification, was found to be identical with the tribromorcin described by Stenhouse,* and subsequently examined by Laurent and Gerhardt,† and by Samparter.‡

Analysis of Pentabromorcin.

I. 0·578 substance gave 1·046 argentic bromide, which is equivalent to 77·00 per cent bromine; the formula $C_7H_3Br_5O_2$ requiring 77·07 per cent.

Pentachlororcin hypochlorite,

$$C_7H_4Cl_6O_3 = C_7H_3Cl_5O_2,HClO.$$

A white crystalline substance was obtained in endeavouring to prepare pentachlororcin by the action of calcium hypochlorite and hydrochloric acid on orcin; but as it appeared to differ somewhat from that compound it was carefully examined. After some trials the following was found to be the best method of preparation:—Five parts of orcin were dissolved in a mixture of four measures of hydrochloric acid, sp. gr. 1·17, with four measures of water; and this solution was then gradually added to a

* *Ann. Chem. Pharm.*, cxxx., p. 34; Kekulé's "Benzolderivate," i., p 388.
† *Phil. Trans.*, 1848, p. 87.
‡ *Ann. Chem. Phys.* [3], vol. xxiv., p. 317.
§ *Ann. Chem. Pharm.*, vol. xxxiv., p. 257.

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moderately strong clear solution of calcium hypochlorite, taking care to leave the latter in excess. The liquid, which has a milky appearance, was then strongly acidulated with hydrochloric acid, and allowed to stand 24 hours, when it deposited a considerable quantity of white crystals. These were collected, dried, and purified by crystallisation from benzol, as, unlike pentachlororcin, they are but sparingly soluble in carbon disulphide. When pure it crystallises in transparent prisms of great dispersive power. It is very soluble in ether, moderately so in light petroleum oil, and almost insoluble in water. When heated with hydriodic acid and phosphorus it is decomposed, but apparently without the formation of trichlororcin. It is very soluble in alcohol, and after boiling the solution for some time, the addition of water causes the precipitation of an oil, which solidifies if exposed to the air for a few days. When the substance is boiled with water the latter becomes milky, and gives off pungent vapours. The hypochlorite dissolves in hot nitric acid, and crystallises out on cooling; hot concentrated sulphuric acid decomposes it. It has a considerably higher melting-point than pentachlororcin, namely 140·5°. The following results were obtained by analysis:—

I. 0·272 grm. substance gave 0·240 grm. carbonic anhydride and 0·033 grm. water.

II. 0·274 grm. substance gave 0·242 grm. carbonic anhydride and 0·032 grm. water.

III. 0·257 grm. substance gave 0·633 grm. argentic bromide.

IV. 0·147 grm. substance gave 0·361 grm. argentic bromide.

	Theory.		I.	II.	III.	IV.	Mean.
C_7	= 84 =	24·07	24·06	24·08	—	—	24·07
H_4	= 4 =	1·15	1·31	1·34	—	—	1·32
Cl_6	= 213 =	61·03	—	—	60·94	60·75	60·85
O_3	= 48 =	13·75	—	—	—	—	—
	349	100·00					

The rational formula deduced from the percentage composition of the substance is $C_7H_4Cl_6O_3$, and I propose to give it the provisional name of *pentachlororcin hypochlorite*, $C_7H_3Cl_5O_2$, HClO, until its constitution is more satisfactorily made out by an examination of the products of its decomposition.

Chlorresorcin.

Pentachlorresorcin, $C_6HCl_5O_2$.—An attempt was made to obtain a chlorresorcin by submitting resorcin to the action of chlorine hydrate in a manner similar to that which had been so successfully employed in preparing pentachlororcin, but the results obtained were unsatisfactory, the product being very small in comparison to the resorcin taken, and even that so contaminated with oily impurities that further examination was deemed inexpedient. The action of potassium chlorate and hydrochloric acid, however, gave a much more favourable result. Five parts of potassium chlorate and a solution of two parts of resorcin in eight of hydrochloric acid were gradually added to forty parts of hydrochloric acid, which was prevented from becoming very hot by immersion in cold water. The operation was conducted in a manner similar to that previously described in the preparation of pentachlororcin, but more care was required to obtain a successful result, and the amount of product was comparatively small, about 70 per cent of the resorcin. The crystalline compound which is deposited on standing was collected, and, after being simply pressed to remove some of the mother-liquor, boiled with a considerable quantity of carbon disulphide. The supernatant aqueous layer was then separated by means of a separating-funnel, and the greater portion of the carbon disulphide removed by distillation. When sufficiently concentrated the anhydrous chlorresorcin crystallised out in brilliant colourless plates or flattened prisms. One or two re-crystallisations rendered it pure. The crude product of the action of the chlorate and hydrochloric acid on resorcin appeared to consist principally of a hydrate of the chlorresorcin, as when it was rapidly heated for a short time with a comparatively small proportion of carbon disulphide, and the solution filtered, it deposited a white crystalline compound in minute scales, sparingly soluble in the disulphide. On submitting the solution to distillation, however, to remove the excess of carbon disulphide, water passed over with the latter, and the solution, when sufficiently concentrated, deposited large crystals of the anhydrous substance. Pure pentachlorresorcin is colourless, and melts at 92·5°. It is moderately soluble in warm water, from which it separates on cooling in a white opaque mass of indistinct crystals, apparently the hydrate. It is readily soluble in carbon disulphide, benzol, and petroleum oil, and very soluble in alcohol and ether.

Analysis of the Chlorresorcin.

I. 0·476 grm. substance gave 0·447 grm. carbonic anhydride and 0·020 grm. water.

II. 0·308 grm. substance gave 0·289 grm. carbonic anhydride and 0·013 grm. water.

III. 0·193 grm. substance gave 0·490 grm. argentic chloride.

IV. 0·259 grm. substance gave 0·659 grm. argentic chloride.

	Theory.		I.	II.	III.	IV.	Mean.
C_6	= 72·0 =	25·49	25·56	25·60	—	—	25·58
H	= 1·0 =	0·35	0·47	0·47	—	—	0·47
Cl_5	= 177·5 =	62·84	—	—	62·81	62·95	62·88
O_2	= 32·0 =	11·32	—	—	—	—	—
	282·5	100·00					

The results of the analysis correspond very nearly to the formula $C_6HCl_5O_2$, that of pentachlorresorcin. This somewhat anomalous composition was, however, confirmed by the analyses of the corresponding bromine compound.

Bromresorcin.

Pentabromresorcin, $C_6HBr_5O_2$.—This compound was prepared by adding resorcin solution to a mixture of bromine and water, in a manner similar to that employed in the preparation of pentabromorcin. It is, however, advantageous to use considerably less water (about one-fifth), and to moderate the heat produced during the reaction by occasionally immersing the bottle in cold water. Two or three crystallisations from carbon disulphide serve to purify the product, which then forms large colourless or faintly yellow prismatic crystals. The pure pentabromresorcin melts at 113·5°. It is almost insoluble in water, but readily soluble in ether and alcohol, from the latter of which it is precipitated on the addition of water. It is also moderately soluble in cold benzol and in hot petroleum oil, from which it crystallises out in great part on cooling. Treated with hydriodic acid it yields a colourless compound, crystallising in needles, probably tribromresorcin.

Analysis of Pentabromresorcin.

I. 0·382 grm. substance gave 0·712 grm. argentic bromide.

II. 0·292 grm. substance gave 0·544 grm. argentic bromide.

	Theory.		I.	II.	Mean.
C_6	= 72 =	14·25	—	—	—
H	= 1 =	0·20	—	—	—
Br_5	= 400 =	79·21	79·30	79·27	79·28
O_2	= 32 =	6·34	—	—	—
	505	100·00			

The analyses of those chlorine and bromine derivatives of resorcin that have just been described thoroughly establish the existence of the compounds $C_6HCl_5O_2$ and $C_6HBr_5O_2$, which closely resemble in their properties the corresponding pentachlororcin, $C_7H_3Cl_5O_2$, and pentabromorcin, $C_7H_3Br_5O_2$, obtained from ordinary orcin. The view of the constitution of the orcins put forth by Kekulé, who regards them as dihydroxyl derivatives of the benzols, is scarcely in accordance with the method of formation

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and composition of these compounds, as in the case of the pentabromresorcin five hydrogen atoms in the resorcin are undoubtedly directly replaced by bromine, although one of them, according to Kekulé's view, exists as hydroxyl.

An attempt was made to prepare the resorcin body corresponding to that obtained from orcin by the action of calcium hypochlorite and hydrochloric acid, and which I have designated pentachlororcin hypochlorite, but without success. The product was a very viscid oil, which showed no signs of solidification even after standing for some weeks, and from which I was unable to obtain any crystalline compound.

NOTE ON CUPREOUS OXIDE.

By C. T. KINGZETT.

DURING some recent researches I had occasion to ascertain if cupric oxide is formed by blowing air through water holding in suspension cupreous oxide.

In view of this object, a considerable quantity of cupreous oxide was prepared by the addition of a strong solution of ordinary moist sugar to a solution of cupric sulphate after treatment with an excess of potassic hydrate.

The Cu_2O was washed thoroughly first by decantation (the readiest method), and afterwards upon a filter. It was then approximately dried at 212° F.

(*a.*) The value of 10 grs. by weight, ascertained by the method based upon the following reaction :—

$$Cu_2O + Fe_2Cl_6 + 2HCl = 2CuCl_2 + 2FeCl_2 + H_2O,$$

and titration of the ferrous chloride thus formed with a standard solution of potassic bichromate. 10 grs. contained actually 9·13 grs. Cu_2O.

(*b.*) 9·13 grs. Cu_2O placed in 1000 grn. measures of "steam-water," and air blown through for three hours, keeping the vessel hot by the aid of a Bunsen burner (a cylindrical vessel serves best—such as a big "boiling-tube.")

The Cu_2O did not alter in appearance, and on determining the Cu_2O left after blowing it was found that *none had peroxidised.*

(*c.*) Same as (*b*) repeated *cold.*

Same results as in (*b*).

After performing these simple experiments it occurred to me that the presence of an alkali might induce peroxidation.

(*d.*) 9·13 grs. Cu_2O placed in 1000 grn. measures of a solution containing 20 grs. pure sodic hydrate. Heated by Bunsen burner and air blown through for one hour.

After experiment, the Cu_2O left was 4·5 grs.; therefore, 50 per cent (roughly) had been peroxidised.

The NaHO left in solution was also estimated by standard hydric sulphate.

The whole of the 20 grs. originally present was found still in solution.

(*e.*) This was (*d*) repeated, using 10 grs. NaHO and blowing for three hours. 2·3 grs. Cu_2O were left behind. 75 per cent (roughly) had been peroxidised. All the alkali remained unaltered in solution.

(*f.*) This was (*e*) repeated. Blowing five hours. The whole of the 9·13 grs. Cu_2O peroxidised. All the alkali remained unaltered in solution.

The progress of the peroxidation may be watched by the gradual blackening of the scarlet-coloured Cu_2O: this "blackening" occurs only slowly if Cu_2O suspended in an alkaline solution be left in *contact* merely with the air.

As might be expected, the peroxidation (as determined by other experiments, continued for equal times and with the same rates of blowing) proceeds far more rapidly hot than when cold.

As already stated, the preceding experiments were made with Cu_2O that had been *dried.*

A similar series were made with recently precipitated Cu_2O without drying, but exactly similar results were obtained.

How the hydrated cupreous oxide $4Cu_2O,H_2O$, prepared by addition of potassic hydrate to cupreous chloride would behave when made the subject of parellel experiments, I have not yet had an opportunity of deciding.

No doubt caustic soda or potash induces the peroxidation of anhydrous cupreous oxide as they do the oxidation of ethylic alcohol to acetic and formic acids,—that is, by a catalytic action. It is just possible that Na_2O_2 or K_2O_2 may be temporarily formed and almost spontaneously decomposed.

Whilst experimenting with cupreous oxide, I conceived the idea that it might decompose potassic bichromate and be oxidised to cupric oxide at its expense. Accordingly,

(*g.*) 9·13 grs. Cu_2O were boiled with 1000 grn. measures of standard bichromate solution, capable of peroxidising 50 grs. $FeSO_4,7H_2O$. Filtered and washed, and filtrate and washings examined. They oxidised 50 grs. of ferrous sulphate.

The Cu_2O had not altered in appearance. This experiment therefore shows that, unlike cupric oxide, cupreous oxide is without action upon potassic bichromate.

FIBRIN: ITS ORIGIN AND SOURCES OF DEVELOPMENT IN THE ANIMAL ORGANISM;

VERITABLE FIBRIN BEING PROVED TO BE DERIVED FROM ALBUMINOUS SUBSTANCES BY THE AGENCY OF WATER.

By JOHN GOODMAN, M.D., &c.

THE intense importance of the inquiry which is the subject of this paper is well known to all physiologists.

The author having read a paper on this subject at the Liverpool meeting of the British Association, which is published in the report, has been since that period engaged in attempting to prove, by a long and complete series of experiments, the truth then set forth.

The following is an epitome of the results arrived at :—

1. Albumen, from the egg, suspended in ropes in cold and pure water, and exposed for some little time to its influence, loses its character of albumen, and assumes the nature, appearance, and constitution of fibrin spontaneously. Thus, it coagulates, and independently of the application of heat, and becomes solid and insoluble—characteristics which distinguish fibrin from all other analogous substances (see Dr. "Miller's Organic Chemistry," Part III., p. 800).

2. Under the microscope, which was used in all these experiments, when thus transformed by water, it exactly resembles blood fibrin, with the reactions, &c., of which it was constantly compared. So great was the resemblance that a medical gentleman from Manchester selected this substance under the microscope for the real genuine blood fibrin, in preference to a specimen of the fibrin substance itself.

3. *Intense Affinities and Formative Qualities.*—Blood fibrin, and especially this substance, differ from albumen in possessing intense attractive powers and affinities, which appear to be the secret cause of the formative qualities of fibrin; causing it to form, in definite lines, into rods and substances, &c., which evince the presence of a controlling constructive power, and enabling it to assume forms and grotesque figures, of which it might be said that nothing but vitality was wanting to endow them with the character of living beings. In several instances, the fibrin *ab* albumen as we will now call it, manifested decided electrical attraction, for it was drawn aside and out of its perpendicular, in several instances, some ¼ inch or so, by attractive influence towards a copper wire when raised from the water. On the other hand, albumen presents itself as a homogeneous, motion-

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less, and shapeless mass, and entirely destitute of these powers and characteristics.

4. Like blood fibrin, it was found to decompose peroxide of hydrogen with effervescence, whilst, as stated by Dr. Miller (p. 806), "albumen produces no such effect." Again, Dr. Miller tells us that neutral salts, mixed with blood, on abstraction, prevent its coagulation. This we found to be the case with regard to this substance—even sea water prevented, in a great measure, the transformation.

5. *Is Oxygen capable of effecting this change.* — Dr. Miller declares (p. 807) that "There is a great difference between the action of oxygen on albumen and fibrin. That the former, when exposed to oxygen, enclosed in a glass tube, over mercury, indicates scarcely any absorption of the gas, and little or no carbonic anhydride is eliminated; but when coagulated fibrin is exposed, in a moist state, to the air, it gradually absorbs oxygen, emits carbonic anhydride, and in a few days becomes putrid." I found that fibrin *ab* albumen, as well as blood fibrin, has a great affinity for oxygen, especially when moist and verging on decomposition, whilst albumen, in ropes hung up in the atmosphere, remained untirely unchanged in its nature, save that it became a brittle rod.

In order to show that oxygen of the air takes no part in this transformation (in Expts. 102, 103), I found that the transformation of albumen into fibrin proceeded exactly similarly in two bottles, the one closed by a stopper, the other open to the atmosphere—no perceptible difference occurring between them for days and even weeks.

In all these experiments I have not discovered one instance in which oxygen has shown itself capable of effecting any change in albumen without the previous intervention of water.

6. There is, however, an experiment on record, as given by Dr. Carpenter, in which Mr. Smee is said to have produced a substance presenting numerous points of similarity to fibrin, if not identical with it, by passing oxygen through defibrinated blood serum to which ordinary ov-albumen has been added, or through albumen slightly acidified with acetic acid (see Dr. Carpenter's "Principles of Physiology," p. 56).

In these experiments, pure ov-albumen, or albumen alone, was not employed. In the one case it was mixed with blood serum, and perhaps with water, of which we are not informed, and in the other with acetic acid.

7. In the first experiment by Mr. Smee the serum employed had been of course exposed to the agency of water in several instances in the animal organism, and therefore, even when defibrinated, as shown by Muller,* and mixed with water, coagulates after passing a filter. In the other acetic acid was used, and the water which it contains was, we contend, sufficient to induce the change in question.

But there are no acetic or other strong acids in the lymphatics and lacteals in which fibrin is at first seen to derive its origin, and therefore the latter experiment has nothing to do with the subject in hand.

I find, by experiment, that we have in blood serum always—

(1). Already formed fibrin in solution ready to coagulate.

(2). Do., do., which will manifest itself on exposure to the air.

(3). The remaining albumen, which is all capable of transformation by being diluted with water.

Ov-Albumen with Oxygen.

Expt. 99.—In order to prove or disprove Mr. Smee's experiment as regards simple albumen itself, I exposed *ov.* albumen to a stream of oxygen in a glass tube for six hours, and afterwards for forty-eight hours to bubbles of the same still remaining in the albumen. At the end of this time its transparency remained unaltered,—it was slightly more yellow—and the bubbles were somewhat diminished in size. There was no appearance under the microscope of any fibrin having been formed. The albumen was unchanged.

8. *Expt.* 100.—In order to show the effect of the addition of water to the above, the tube and contents were merely washed out with the same, when it at once assumed an opaque white appearance. In five to ten minutes, under the microscope, fibrous rods and other formations began to manifest themselves, and after two days' exposure to water, the whole had become changed completely into fibrinous material.

Gulliver kept horses' blood fluid with nitre for 57 weeks, yet it readily coagulated when diluted with water (Dr. Carpenter's "Physiology," p. 238).

9. These experiments therefore declare that oxygen is not the producing cause of this transformation, but albumen requires first the agency of "moisture," "dilution," or water, to change it into fibrin before oxygen can exert any influence upon it of this kind. Afterwards, it seems to endow it with new qualities and a higher state of organisation, and gives, as it were, the finishing touch to this important product. Such also appears to be the case in the animal organism. Albumen is transformed into fibrin by water in the lymphatics and lacteals, &c., and afterwards in the liver and vena cava by water absorbed by the gastric veins, and then its organisation is rendered perfect and complete by respiration.

In the animal and vegetable kingdom we observe that the most tiny animalcule or vegetable substance does not start into existence independently of the presence of water. It appears that fibrin has to be first formed by the action of water before even the germ can exert its living influence upon it and develope a living being, and endow it with its own nature and species. We also notice that fermentation, decomposition, and scarcely any chemical change in living or dead organic substances can occur without the presence of water.

It appears, moreover, that this substance, fibrin *ab* albumen, exactly resembles fibrin when first formed in the lymphatics. Dr. Carpenter has shown that the latter differs from blood fibrin in its inferior tendency to putrefaction (p. 180), whence, says he, "It may be inferred that it has not undergone its complete vitalisation." This substance also possesses a very low degree of putrefactive tendency, for it remained in water three whole weeks (see Expt. 5), perfectly white and beautiful, as on its first formation, and did not become decomposed for several days afterwards. Oxygen, however, evidently confers upon fibrin increased attractive and formative qualities; many more rods, &c., presented themselves generally after this substance had been exposed to the air in most of these experiments.

10. *Expts.* 105, 107, 108, 109.—When the cold water was exchanged for that of blood heat, *i.e.*, from 98° to 100° or more F., no difference was observable in the rapidity or potency of the transformation.

11. Mr. Smee is said, moreover, to have produced a substance very similar to, if not identical with, fibrin, "by feeble currents of electricity passed through an albuminous fluid, where it accumulates round the positive pole." It appears pretty clear that water was here employed,—by the words "fluid" and "accumulation" round the pole being used (see Dr. Carpenter's "Principles of Physiology," p. 56).

Ov-Albumen with the Voltaic Current.

Expt. 116.—In order to test this experiment more particularly, I employed ov-albumen alone between the two platina poles of a voltaic battery of six cells.

I found that there were only a very few small specimens of fibrin produced under the microscope, but that the albumen, by decomposition and effervescence, became less and less fluid, the fibrin apparently being transformed by the water of fluidity,—compelled, as it were, by the

* "Elements of Physiology," by J. Muller, M.D., translated by Dr. Baly (p. 124).

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influence of the voltaic current,—and very shortly all transformation ceased. After a time, the albumen became a thickened and ultimately a solid mass. On examination, it was found to consist almost entirely of unchanged albumen, as the specimen which we have here manifests.

Ov-Albumen with Water and the Voltaic Current.

12. *Expt.* 110.—I employed water in this experiment and those following in conjunction with the voltaic current. In half a minute the albumen became covered with dense and opaque whiteness, showing that, in contrast with the other experiments, in which the influence of water only was used, the rapidity of transformation was, by electric agency, greatly increased.

Expt. 112.—The change to dense and opaque white was again effected in about half a minute. With older ov-albumen there is usually an increase in the amount of gas eliminated. Here we had a globule of albumen immersed in water midway between the poles, which was found to be a great advantage. In this experiment I perceived a dense dark brown ring of fibrin forming around each bubble of gas, which we have preserved, and which can now be seen in the specimen. In fifteen minutes fibrinous rods were seen shooting forth like the fingers of a human hand (one of the most beautiful exhibitions I ever witnessed), towards the negative pole or in the lines of current.

All these expefiments, together with 113 and 115, in which, apparently, thousands of ovoid corpuscles made their appearance, many of which were attracted in beautiful lines, and formed rods, and many of them can still be seen in the specimen, resulted in the formation of perfectly formed fibrin, without scarcely a vestige of unchanged albumen being left.

Dr. Miller declares (p. 808) that, when fibrin is treated with acetic acid under the microscope, it is found to consist of two portions, one of which is granular and soluble in acetic acid, while the other is fibrinous and insoluble. This we found to be a graphic description of what took place with *ab* fibrin albumen.

Fibrin *ab* albumen remained unchanged in water for three entire weeks. But about the 25th day (the water being muddy with albuminous matter) it began to break up bodily into fibrinous rods and shreds of an indubitable character.

EPITOME OF CHEMICAL EXPERIMENTS.

I.—*Solution.*

Expt. 9 and 69.—Fibrin *ab* albumen dissolved in 3 mins. in liq. potassæ.

Expt. 66.—Blood fibrin was completely dissolved in twelve hours, whilst ov-albumen required more than twenty-four hours to effect its solution without heat. Here this substance was much more dissimilar to albumen than even blood fibrin itself.

Expt. 52.—In strong hydrochloric acid, fibrin *ab* albumen and blood fibrin both dissolved in twenty-four hours, whilst ov-albumen was not completely dissolved in sixteen days.

II.—*Precipitated Solutions.*

In solution in acids precipitated by alkalies—and in alkalies precipitated by acids—this substance always manifested the same reactions as blood fibrin, and also equally differed from those of albumen. Expts. 57 to 63 and 68.

In the fibrinous solutions precipitated, we had always fibrinous rods and formations of fibrin without the coagulum peculiar to albumen. In the solutions of albumen precipitated, we had as invariably a dense and dark or light coagulum, without fibrinous rods and formations.

Moreover, in alkaline solutions of albumen with acetic acid, we had always a dense white and flocculent coagulum; and when precipitated by nitric acid, as stated by Dr. Miller,* a lemon-yellow precipitate, whilst neither coagulum nor colour were present in the precipitates from solution of fibrin *ab* albumen, or blood fibrin.

The results of these experiments again and again repeated have been so marked, so harmonious, and constant, under the microscope, as to give them a conclusiveness which demands our most serious consideration and attention.

(To be continued).

* Dr. Miller's "Organic Chemistry," part iii.

SEWAGE AS A FERTILISER OF LAND, AND LAND AS A PURIFIER OF SEWAGE.*

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Hon. Member of the Royal Agricultural Societies of Norway, Sweden, and Hanover.

(Continued from vol. xxiv., p. 309)

I. *Chemical Treatment of the whole of the Sewage at the Mouth of the Sewer.*

LEAVING out of consideration all treatments which aim only at the purification of the sewage, without turning its fertilising properties to use, as irrelevant to my subject, I will confine my observations to those chemical processes by which both these objects are said to be obtained. Many processes have been before the public aiming at this end, and several have been patented, and afterwards brought forward by public companies.

The Native Guano Company, better known as the company possessing the patent of the "A B C Sewage Process," now stands very prominently before the public in consequence of its shares being at a high premium, and because arrangements have been made by the authorities of Hastings, Leeds, Bolton, and Southampton, as well as by the Metropolitan Board of Works, to test, by comprehensive experiments, the value of the process, although it had been superseded at Leamington by irrigation. The initials "A B C" indicating the principal ingredients of the chemical mixture, viz., alum, blood, and clay, by which it is stated the polluting and fertilising parts of sewage may be precipitated and made available as a manure. I do not propose to enter into any details of the process itself, but will merely state that the specification of the patent sets forth that 4 lbs. of mixture are required for every 1000 galls. of sewage treated; and that Mr. Rawson, the general manager of the company, tells me that 100,000 gallons of sewage of average strength—diluted to the extent of 30 gallons a day—will produce from 20 to 25 cwts. of dry manure; from which statement we see that, if the specified proportion of mixture to sewage were adhered to, 400 lbs. of mixture will be required for the production of a ton of saleable manure. The company declare that deodorisation takes place immediately on the first addition of the A B C mixture, and in proof of the purification effected, give the following analyses:—

Comparative Analysis in Grains per Gallon.

	Average of 50 samples.	
	Sewage.	Effluent Liquid
Organic Matter	17·2	1·4
Mineral matter	37·4	16·9
Total	54·6	18·3

I will now offer such evidence as I can of what the Native Guano Company can do towards the purification of sewage and the extraction of its fertilising parts, premising that Mr. Rawson has most courteously afforded me every facility for ascertaining the results arrived at by farmers and gardeners who have used the manure sold by the company.

The Rivers Pollution Commissioners, having made very careful experiments at Leicester and Leamington, state

* Read before the Society of Arts, December 6, 1871.

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in their second report (dated July 4th, 1870), that the process removes a very small proportion of the soluble polluting matter from sewage, and that "the manure obtained has a very low market value, and cannot repay the cost of manufacture." Their analysis of the effluent liquid, made of samples taken on the 10th of May, 1870, showed the following result, although the quantity of mixture used was increased very largely beyond the proportion prescribed in the specification (4 lbs. to 1000 gallons of sewage).

Analysis expressed in parts per 100,000:—

Total solid matter in solution ..	123·050
Organic carbon	4·727
Organic nitrogen	1·892
Ammonia	8·060

These figures are very much in excess of those I have just quoted as given by the company; though, if the latter were compared with either the standard of purity suggested by the Rivers Pollution Commissioners or that recommended to the Thames Conservators, it will be seen that the condition indicated is not such as to render the effluent liquid admissible into running streams. How Leeds and the other towns mentioned will ultimately conform to a national standard of purity remains to be seen. As to the manure made by the Native Guano Company, the Commissioners said that "the so-called A B C manure is little more than the original suspended solid matter of raw sewage, plus the insoluble materials added in the A B C mixture, 19-20ths of this being merely clay."

The chemists employed by the Metropolitan Board of Works state, through Dr. Odling (June 24th, 1870), when speaking of this process, that, after examination, they found "there was a great deal of putrescible matter in the effluent liquid; and in comparing this mode of precipitation with others, it did not seem that its alleged superiority had any foundation."

Dr. Voelcker, in the *Journal of the Royal Agricultural Society* (vol. vi.. S.S., Part II.), having analysed five different samples of the manure sold as native guano, stated the result to be as follows:—

	£	s.	d.	
No. 1 sample was worth ..	0	18	6	per ton
2 „ „ ..	1	13	6	„
3 „ „ ..	0	14	0	„
4 „ „ ..	0	18	6	„
5 „ „ ..	0	14	6	„

basing his value on a comparison of the manure with phosphate of lime at £10 a ton, and ammonia at £60 a ton.

Still, in the face of these adverse opinions, expressed by the highest chemical authorities of the country, the Native Guano Company is advertising its dried manure at £3 10s. per ton, and are finding customers at that price. Some farmers and gardeners with whom I have corresponded speak very favourably of it, and declare their intention of buying more, while others say they have not been able to distinguish any advantage from the use of it, and one farmer goes so far as to threaten an action for injury done by its use. On the whole, the replies I have received do not lead me to the conclusion that the sale of the manure will be very great after public curiosity is satisfied, for it is more than probable that the sales that have taken place have resulted from the desire to give the manure a trial, under a false notion that because Peruvian guano is advertised at £13 5s. a ton, and phospho-guano at £11 10s. a ton, "native guano" must be cheap at £3 10s. a ton. If, however, the sale should continue, the failure of the process to effect purification up to any recognised standard must act as a veto to its adoption, except in those cases where the authorities of towns may be content with clarified in the place of purified sewage.

The Phosphate Sewage Company, founded on a patent taken out by Dr. David Forbes, of which dissolved phosphate of alumina for precipitation is the base, aims at doing all that the A B C process professes to do, with the additional recommendation of being associated with irrigation where circumstances favour the adoption of the two processes, which, seeing that the separation of the coarser solid parts of sewage from the liquid is a desideratum in irrigation, may frequently be the case. The company state that, "if phosphate of alumina alone is used, the sewage is defecated, the solid matter is precipitated, and the water is left still maintaining all its nitrogenous and valuable properties, plus any excess of phosphoric acid which has been added, and, therefore, highly useful for the irrigation of cereals and other crops, and at the same time perfectly inoffensive. This process will be adopted where it is deemed desirable to use the water as a fertilising agent for irrigation purposes, since it possesses advantages, both in an agricultural and sanitary point of view, above any system of sewage irrigation hitherto used. In the case of towns to which sewage irrigation is inapplicable or disadvantageous, and which are desirous of rendering their sewage water sufficiently clear and pure to return into a river or stream, this object can be effected by adding a small quantity of lime to the sewage after treatment by the former process." This company, in fact, declares itself able not only to purify sewage to a degree to render it admissible into rivers, and to manufacture a manure out of the precipitated matter, but to render the effluent liquid more suitable for irrigation than the sewage itself. These statements are made on the authority of Dr. Voelcker. The analysis of the effluent liquid discharged during certain trials at Tottenham gives the following result in grains per imperial gallon:—

Organic matter—		
In solution	5·74	
In suspension	none	
Total organic matter		5·74
Mineral matter—		
In solution	57·71	
In supension	none	
		57·71
Total solid matter (organic and mineral)		63·45
Organic nitrogen—		
In solution	0·47	
In suspension	none	
Total organic nitrogen		0·47
Equal to ammonia	0·57	
Saline ammonia	3·32	
Total nitrogen calculated as ammonia	3·89	

Compared with the suggested standard of the Rivers Pollution Commissioners, this analysis does not show the requisite amount of purity.

I have endeavoured, from information supplied me by Mr. Lonsdale, the secretary of the company, to obtain some tangible proofs of the value of the manure manufactured by the company, but the number of instances are so few in which actual trial has been made on a scale affording any practical test, that I confess myself unable to draw any deductions whatever; and when stating there can be no doubt that a valuable manure may be made by mixing with the fertilising parts of sewage the phosphate of alumina, it must be borne in mind that there exists no proof that the manufacture will be attended with profit. It must also be remembered that the operations of the company depend upon the supply of phosphate of alumina, which, like all other foreign importations obtained from a distance, must be liable to vicissitudes bearing upon the fortunes of the company, and on the interests of those towns and districts having dealings with it. Associated with irrigation

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as a never-failing resource when the phosphate may not be forthcoming, or when the manure may not command a sale, such objections would not exist.

With certain seaboard towns, where the effluent sewage need only be clarified to be free from objection, this company, like the Native Guano Company, may probably do a large amount of work, if it should turn out that a saleable manure may be profitably made; though, with the experience we are now having of the power of a small quantity of natural soil to cleanse a large body of sewage by intermittent filtration, and to grow crops at the same time so that the scavenging powers of vegetation may render their aid in purification (as I shall presently show may be the case), it will probably be found more economical to have recourse to that process which is attended with no nuisance whatever, than to establish manure manufactories with all the attendant risks.

Not having any information to offer with regard to the Peat and Engineering Company, nor of any other chemical or chemico-mechanical processes which deal with the sewage at the sewer mouth, I have nothing further to add about that class of treatment. I will merely repeat that it is daily becoming more generally acknowledged, and acted upon, that "the present resources of chemistry appear to hold out no hope that the foul matters dissolved in sewage will be precipitated and got rid of by the application of chemicals to the offensive liquid; and that, therefore, we must look to the direct application of sewage to land wherever it can be obtained for the purpose, as the most desirable means of recovering from water those "ingredients held by it in solution and suspension which do not belong to it, and which render it objectionable and unfit for ordinary and domestic purposes.

II. *Transport of the whole Sewage in its Liquid State from the Sewer Mouth direct to the Land, for Distribution on the Surface.*

So much has been written and said recently on the practice of sewage irrigation, that I should be disposed to say very little on the subject, had not the special properties of the soil itself for appropriating the fertilising matter of sewage, and for cleansing the sewage itself, been, to a very great extent, omitted from consideration, and had not Boards of Health—the worst farmers in the world—been the principal cultivators up to the present time. Believing that, with a recognition that the soil will perform the functions accredited to vegetation as, or more, effectually than vegetation itself, and that the two in combination will obtain the best results, both as a means of profit and as a sanitary agency, I regard all calculations that have hitherto been made as to the number of persons contributing sewage per acre, and the rules that have been laid down on that score, as worth very little as a guide for the future, when the principle shall be fully recognised that the surface of land must be rendered so absorbent that no sewage shall pass off it into the river courses.

In the application of sewage to land, the local features will, in future, decide the question whether the purification of the sewage and its profitable use should be treated as objects of equal importance, or whether the purification should be the paramount object, and utilisation a subsidiary one. If sufficient land for wide irrigation is not to be obtained, or if obtained only at a price that shall place the application of the sewage, by way of irrigation, beyond the possibility of profit, it is manifest that we must call to our aid the cleansing powers of an aërated soil, and regard the land more in the character of a filter than we have hitherto been disposed to do; and by adopting intermittent application, the effect of which has been so admirably explained by the Rivers Pollution Commissioners, realise all the advantages to be gained from it.

The two processes of irrigation and filtration are already viewed so differently from the way in which they were regarded in their first introduction, that it is necessary to state how we stand with regard to them at the present moment. It will be remembered that, up to very recently, an opinion prevailed with respect to irrigation that "the object of getting sewage on to the land was, not to let it percolate into the ground, but to keep it on the surface," and that subsoil drainage would not do for sewage farms, because the sewage passed too rapidly to the roots of vegetation, and descended downwards.

Under-drainage as Essential to Irrigation as to Filtration.—Some members of this Society may remember, on the occasion of my reading a paper on "The Water Supply of the Metropolis, in relation to the Thames and its Tributaries," my friend Mr. Rawlinson, who has ever been the consistent and able advocate of the application of sewage to land, stated in this room, without giving any opinion himself, that some persons practically "acquainted with sewage irrigation would prefer, from their experience, to irrigate clay lands without under-drainage, if Italian rye-glass, which was the most profitable crop, were to be sown; and the little difference of effect that was to be noticed at Norwood, where the land was clay, and the manager had actually plugged the drains in order to keep the land in a state of supersaturation, when compared with Croydon, where the land is free and is naturally drained, has often been quoted as a reason why sewage irrigated land should not be drained. I will not stop to condemn this view, which is repugnant alike to the sanitarian and the agriculturist, as it may be already observed that, with very few exceptions indeed, operators now disclaim the opinion that under-drainage is unnecessary. So decided has the appreciation of drainage become with the majority of sewage irrigators, that in the eagerness to secure rapid absorption, sewage farms have become filter beds of too rapid action, and by the adoption of inappropriate drains the purifying powers of the soil have been jeopardised. Short as the interval has been since intermittent downward filtration was first suggested by the Rivers Pollution Commissioners, that process has, like irrigation, undergone a change. The Rivers Pollution Commissioners stated—evidently under the impression that sewage would only be applied to a barren or fallow surface—"That with a properly constituted soil, well and deeply drained, nothing more would be necessary than to level the surface and divide it into four equal plots, each of which in succession would then receive the sewage for six hours. In this way the sewage of a water-closet town of 10,000 inhabitants could, at a very moderate estimate, be cleansed upon 5 acres of land, if the latter were well drained to a depth of 6 feet." They then go on to state that, nevertheless, there are three formidable objections to the general adoption of the process:—(1) "It is entirely unremunerative." (2) "The whole of the manurial ingredients of the sewage would be absolutely wasted." And (3) "The collection of solid fæcal matters upon the surface of the soil, with no vegetation to make use of them, would probably give rise to a formidable nuisance, especially in hot weather." The change to which I have referred has arisen on the proof which I have had the satisfaction myself of affording, that vegetation may be grown upon the surface of filtering areas, even when receiving sewage equal to the discharged refuse of 3000 persons to each acre, thus adding, in the most apposite manner, to the cleansing powers of the soil the scavengering properties of vegetation. When speaking presently of land as a purifier of sewage, I shall give the particulars of the instance referred to, which, though the first and only case in which intermittent filtration has been tried and modified by the growth of crops, cannot fail to prove that the objections anticipated by the Rivers Pollution Commissioners may be avoided.

Technical Description of Irrigation and Filtration.—With the general admission that under-drainage is essential wherever sewage is applied to the surface of land, it must now be generally understood that irrigation means the distribution of sewage over as many acres as

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it will wet without supersaturation, having in view a maximum growth of vegetation from the amount of sewage applied, and that any departure from this, resulting in excessive application, is a waste of fertilising matter. It think it may also be taken as proved that filtration through soil should not necessarily mean its application to a fallow or barren surface (as contemplated by the commissioners), but the concentration of the sewage, intermittently, on as few acres of land as will absorb and cleanse it, without excluding the production of vegetation at the same time.

Irrigation.—Having given the interpretation of irrigation as the application of sewage to as many acres as it will wet without supersaturation, I should point out that, owing to the absence of a proper apportionment of the sewage at command to a certain quantity of land, considerable waste has resulted in most instances of sewage farming. The Italian irrigators reckon that they lose half their water when carrying the other half forward for use; and having the advantage of enormous quantities of water to deal with, and a power of regaining that which was absorbed by the soil, by tapping it at a lower level, they are indifferent to loss; but in England, where we reckon the value of sewage by the ton, and have taken its intrinsic value at 1d. per ton, we cannot be content to follow such an example. We must, in fact, in this country reject any mode of distributing sewage which does not aim at the utmost economy, and which I may here state would not be attained, in my opinion, if the average quantity of sewage applied to each acre per annum exceeded 2000 tons, which represents the sewage (proper) of sixty-two persons, with a water supply of 20 gallons a head.

Land may be too Porous.—To judge of the waste resulting from the present mode of applying sewage to the surface of land, we have only to look to the reports of the proceedings of the Lodge Farm, near Barking, published by Mr. Morgan, to whom the public are greatly indebted for the explicit way in which he has given the quantity of sewage applied and of vegetation grown, and we shall see that an average quantity of 4435 tons of sewage per acre were applied during the year ending the 31st of August, 1870, while the quantity used up to the 31st of August last was 3808 tons per acre. If we put ¼d. a ton—which I have said sewer authorities ought to receive for their sewage—on each of these quantities, we find that the payment in the first year would have been £9 4s. 9d., and in the last £7 18s. 8d. Turning again to Mr. Morgan's report, it will be seen that as much as 21,488 tons of sewage have been applied per acre in one field of Italian rye grass. This at ¼d. a ton would amount to £44 15s. 4d. This is the extreme of the year, but taking the whole of the Italian rye-grass produced, it will be seen that the average quantity of sewage applied from the date of sowing was 288 tons for every ton of rye-grass produced and cut. At ¼d. a ton the tenant would have to pay 12s. for this, which is the value of the grass when cut, so that he would suffer a loss of all outgoings in the shape of rent, rates, labour, seed, &c. The waste exhibited by these figures is clearly due to the extreme porosity of the soil, and its unfitness for irrigation on that account.

A Proportion of Clay desirable.—With the limited time at command I must not enlarge upon the advantages certain soils have over others for irrigation. It may be sufficient to state that, if we desire to make the most of sewage, it is necessary that a proportion of clay should exist in the soil, and that, although very stiff clays, from the difficulty attending their management, should be avoided, it is much more likely that soils may be too free than too stiff; I am now, of course, speaking of the retention of the fertilising matter of sewage by the soil, and not of the process of filtration as a means of purification. That is quite another matter. That clayey land is more grateful for sewage is very distinctly shown by Mr. Morgan's report, for the same quantity of Italian rye-grass was produced from clay lands as from free soils, though Mr. Morgan informs me the former did not absorb more than 4000 tons per acre, which is a little more than one-third of the sewage applied to the Italian rye-grass grown on the free soils. I need hardly point out that the rapidity with which land will absorb sewage must depend, not only upon the nature of the soil—its density and porosity—but equally upon the inclination of the surface over which the sewage travels, and the character of under-drainage beneath, and that, therefore, it is the duty of the engineer, when laying out land for absorption, to regulate the inclination of the surface, and the number, position, and size of the under drains *upon which the effect mainly depends* according to the degree of porosity of the soil, in order that a given quantity of sewage may go as far as possible.

Filtration.—Having dwelt upon the practice of irrigation, I ought now to explain the process of intermittent filtration as it may be carried into practice, but as I shall presently deal with it when considering "land as a purifier of sewage," I will only state that by adopting the process as technically described, the liquid refuse of from 1000 to 3000 persons—and probably more—may be cleansed by the soil of a single acre of land.

Return from Irrigation.—Up to this time, though sewage-farming has been practised for some years, we have not obtained sufficient data for the guidance of those who desire to follow it as a business. Although local boards and companies have had the farms in their own hands, no balance-sheets, showing the quantity of sewage applied to, and the money realised by the sale of the various crops grown, have been published. Still, the occasional results that have been obtained affords us positive evidence of what will be done under the management of men practised in the cultivation of land.

The following table exhibits certain results obtained at various places at different dates:—

Description of crop.	Year of production.	Place.	Value of crop per acre.
Italian Rye Grass	1868	Norwood	22 0 0
	1869	Lodge Farm, Barking	25 0 0
	,,	Norwood	25 0 0
	,,	Edinburgh	32 0 0
	1870	Lodge Farm, Barking	37 0 0
	1871	,, ,,	22 0 0
	,,	Warwick	12 14 0
	,,	Banbury	13 16 10
Mangolds	1870	Lodge Farm, Barking	32 0 0
	1871	,, ,,	44 0 0
	,,	Warwick	26 5 0
	,,	Rugby	21 9 0
Swedes	1871	Warwick	26 5 0
	,,	Rugby	18 15 0
	,,	Banbury	14 6 8
Carrots	1869	Lodge Farm, Barking	38 0 0
	1870	,, ,,	45 0 0
	1871	Rugby	45 0 0
	,,	Warwick	35 0 0
Parsnips	1868	Lodge Farm, Barking	35 0 0
	1870	,, ,,	35 0 0
	1871	,, ,,	52 0 0
	,,	Warwick	35 0 0
Cabbages	1868	Lodge Farm, Barking	35 0 0
	1870	,, ,,	15 0 0
	1871	,, ,,	24 0 0
	,,	Banbury	21 11 6
	,,	Warwick	35 0 0
	,,	Rugby	15 0 0
	,,	Merthyr	20 0 0
Potatoes	1869	Lodge Farm, Barking	33 0 0
	1870	,, ,,	25 0 0
	1871	,, ,,	18 0 0
Orions	1869	Lodge Farm, Barking	38 0 0
	1870	,, ,,	62 0 0
	1871	,, ,,	104 0 0
	,,	Warwick	35 0 0

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From these instances sufficient proof is afforded that, with one crop per annum of a kind that will yield largely to the application of sewage, and command a certain and ready sale in the neighbourhood, a sufficient return may be gained to pay a full rent for the land, and a halfpenny a ton for the sewage, besides affording a good profit after paying all outgoings in the shape of rates, taxes, hand and horse labour, repairs and restoration of implements, seeds, interest on capital, &c. It is true that crops as large and even larger than those grown with sewage have been produced by good farming without sewage, and there would be nothing to say specially in favour of irrigation, were it not that the *united* advantages of manure and water ensure crops year after year under every vicissitude of season, and allow of two crops being taken from the same land occasionally. From the experience gained in the cultivation of Italian rye-grass, it is found that it may be readily grown in excess of the demand for it in a green state, and that, as this description of grass is most difficult to convert into hay, it is desirable to limit its growth to a narrower space. It absorbs and appropriates, however, a larger proportion of sewage than any other description of crop, and it is only because it thus helps to swallow up sewage that it is continued to be grown by those who seek rather to get rid of the sewage than to make the most of it. That speciality loses its force directly a fair value is put on the sewage, or when sewage is applied to land which is itself capable of absorbing and cleansing it, as in such case the manurial matter is stored in the soil for use by following crops.

Return from Intermittent Filtration.—The acreage return to the cultivator from the growth of crops on land used for intermittent filtration will depend upon the extent to which the intermittent principle is extended. If several series of filtering beds are adopted, as I have advised in the case of several towns, among which I may mention Birmingham, where the Sewage Inquiry Committee have declared their intention to adopt it, the return will be found quite as great, if not greater than that to be obtained from irrigation; for with the land rendered actively absorbent by drainage and deep cultivation, and laid up in bouts or ridges, crops may be grown while the sewage is being applied without suffering from excess of wetness. By extending the filtering process from one series, as suggested by the Rivers Pollution Commissioners, to several series of areas, so as to give two or three years' rest from filtration, such lands become available for the growth of the greatest amount of vegetation that can be produced from the land; for with the sewage at command any amount of watering that the crops require can be obtained by diverting the sewage for a time from the filtering areas in use. At Merthyr, the money realised by the sale of crops, comprising various roots and cabbages, grown between the 14th of June and the 31st of August last, amounted, on an average, of a day's sale by auction, to £17 15s. per acre, while the crops which were sold afterwards realised upwards of £20 an acre. These figures will bear comparison with the returns from irrigation proper; and I may here state that although the works have been very costly, owing, in a great measure, to their being the first of the kind carried into execution, and in being themselves the result of Chancery proceedings, the chairman of the Board (Mr. William Jones, of Cyfarthfa), says in a letter to me that much as the land and works have cost, "the filtering areas may yet pay;" adding that "had we obtained the land at a fair agricultural value, and the works been executed at the cost they would now be executed for, with acquired experience, I have no hesitation in saying they would be a source of great profit to the ratepayers of this district." These figures and the chairman's opinion are encouraging, and show a fair prospect of profit, if the authorities who have charge of such works abstain from growing the more refined kinds of gardeners' crops, which involve expensive hand-labour, and which are dependent on very fickle markets for sale.

Many considerations lead to the conviction that it will seldom be within the power of the sewer authorities of towns to adopt the widest use of sewage, which would result in the provision of 1 acre for rather more than forty persons, if we adopt the rate I have before stated, of sixty-two persons to 1 acre, with an allowance of 50 per cent additional land for increasing population. With constantly arising opposition, based on a fear of a nuisance (which under proper management will not arise), the difficulty of obtaining land, and the high price to be paid for it, will always stand in the way of wide irrigation. To compensate for the limitation these obstacles will impose, it must not be forgotten that the produce of sewage farms loses much of its value directly it overreaches the home market, and with a large area used for irrigation in the neighbourhood of a town this may be easily done. Already we hear of the produce of the Warwick Sewage Farm being sent to Birmingham, and that of Romford to Liverpool, and various instances of a like kind might be mentioned. One great advantage in the adoption of intermittent filtration, in the shape of concentrated irrigation, is that a greater variety of crops may be grown, and the over-stocking of the market with vegetables avoided, inasmuch as by giving each series of filtering areas a rest of a year or two, the growth of cereals and other crops, which are not successfully grown by ordinary irrigation, would take their part in rotation, and thus dispose of those manurial elements which might otherwise be left in the soil.

It would be too sanguine a view to suppose that the ratepayers of a district adopting the filtration process in its narrowest form would receive as much for their sewage as when irrigation is adopted under advantageous circumstances in its widest form, but it is more than likely that, in a majority of cases, a better return may be gained from a medium course of action than from any other, though it is our duty, in a national point of view, to aim at making the most we can of the valuable matter with which we have to deal.

(To be continued.)

CORRESPONDENCE.

ERRORS IN TEXT-BOOKS: "FOWNES" ON VOLTAIC ELECTRICITY.

To the Editor of the Chemical News.

Sir,—I had written a few notes on the subject mentioned above, when I saw in the Chemical News (vol. xxiv., p. 227) a letter drawing attention to some errors in text-books very properly pointed out by Dr. Watts, and I was confirmed in my intention of sending them to you for publication for the reason mentioned at the close of the letter referred to—viz., that errors in text-books are undesirable.

My notes were to the following purpose:—

In a book so deservedly held in high estimation and so much used in chemical education as Fownes's "Elementary Chemistry," which is now in its tenth English edition, and is reprinted at this stage in the United States, it is most important that there should be no ambiguity even in its teaching, and yet it contains self-contradictions and statements so entirely at variance with accepted views concerning the voltaic pair that students cannot fail to be strangely puzzled on looking at its different pages, to say nothing of comparing these with those of other works.

At page 120 of the American edition, by Prof. Bridges, of Philadelphia, of the tenth English edition of "Fownes," we find, "zinc and platinum put into dilute sulphuric acid constitute an arrangement capable of generating

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electrical force; the zinc being the metal attacked becomes negative, and the platinum remaining unaltered assumes the positive condition." On the opposite page we have—"The polarity or disturbance may be considered to commence at the surface of the metal attacked, and to be propagated through the liquid to the negative conductor, and thence back again by the connecting wire, these extremities of the battery being always respectively negative and positive when the apparatus is insulated. In common language it is said that the current in every active battery starts from the metal attacked, passes through the liquid to the second metal or conducting body, and returns by the wire; hence, in the pile and crown of cups, the current *in* the battery is always from the zinc to the copper, and *out* of the battery from the copper to the zinc, as shown by the arrows." Italics in the book.

At page 250 of the same, in reference to the crucial experiment by which Faraday proved that contact of dissimilar metals is not essential to cause currents, the iodine is said to be separated "beneath the extremity of the platinum wire—that is at the positive *side* of the arrangement." The italics are mine. At the same page we find—"A strong argument in favour of the chemical view is founded on the easily proved fact that the direction of the current is determined by the kind of action upon the metals, the one least attacked being always positive. Let two polished plates, the one iron and the other copper, be connected by wires with a galvanometer, and then immersed in a solution of an alkaline sulphide. The needle in a moment indicates a powerful current, passing from the copper through the liquid to the iron, and back again through the wire. Let the plates be now removed, cleaned, and plunged into dilute acid; the needle is again driven round, but in the opposite direction, the current now passing from the iron through the liquid to the copper. In the first instance the copper is acted upon, and not the iron. In the second, these conditions are reversed, and with them the direction of the current." In the third paragraph from this we learn—"Thus, exactly the same effects are seen to occur in every active cell of a closed circuit that are witnessed in a portion of sulphuric acid undergoing electrolysis; oxygen appears at the positive side—with respect to the current—and hydrogen at the negative, but with this difference, that the oxygen instead of being free combines with the zinc."

Let us compare the clear statement of Miller (vol. i., p. 329, first edit.) with the foregoing:—"In all these cases the positive electricity sets out from the more oxidisable metal, which may be termed the positive or generating plate, and traverses the liquid towards the less oxidisable metal which forms the negative or conducting plate; from the conducting plate the force is transferred to the wire, and thence in turn to the generating plate; thus the circuit is completed." To this may be added No. 108 of Tyndall's "Notes on Electricity"—"The outer ends of two pieces of zinc and platinum partially immersed in acidulated water are in opposite electrical conditions. The free platinum end shows positive electricity, while the free zinc end shows negative electricity."

To revert to "Fownes:" at p. 251 of the edition cited, mention is made of the division of the elements by Berzelius into *electro-positives*, which, like hydrogen and the metals, move towards the negative pole of the battery, as if they were attracted by it, and the *electro-negatives*, which like oxygen, chlorine, and bromine, move towards the positive pole. Presently we find—"Still it is true in a general way that those elements which differ most strongly in their electrical characters, chlorine and potassium for example, are likewise those which combine together with the greatest energy, and the division of bodies into electro-positive and electro-negative is therefore retained; the former are also called *acid* or *chlorous*, and the latter *basylous* or *zincous*." The italics are in the book.

If the obvious confusion in "Fownes" were in a first edition some excuse might be made, but surely it is too much to allow in a book which has passed through so many editions, and through the hands of various editors of high representation. In the interests of teachers and students the necessary corrections ought to be made.

Our friends in the States are said to be fond of reversing the ways of the Old World, but I fancy theirs are rather social and political than scientific reversals, and, I think, you will find all I have pointed out to be also in the English editions. The advertisements of the American publisher, dated May, 1869, says—"So recent and so thorough has been the revision which this work has enjoyed at the hands of the English editors, that but little has remained to be done in preparing the present reprint." It then goes on to state that attention has been directed to secure the accuracy so essential to a treatise of this nature, and that especial care has been devoted to the formulæ.

Hoping that others will be at the trouble of pointing out "errors in text-books," and reminding students that the precept is still worth attention that each must be "Nullius addictus jurare in verba magistri."—I am, &c.,

HENRY HOW.

Windsor, Nova Scotia,
Dec. 14, 1871.

MISCELLANEOUS.

The Royal Polytechnic.—As usual the Christmas programme of this Institution is attractive. It includes two entertainments by Professor Pepper, entitled "Shadows, and the Story of the Shadowless Man," and "The Battle of Dorking, answered by the Autumn Manœuvres." There is also a musical entertainment by Mr. George Buckland, written by the Chairman of the Institution, and other amusing novelties.

NOTES AND QUERIES.

Refining of Paraffin.—"M. P. S." will be glad to be informed, through the CHEMICAL NEWS, where he can find the most recent information on the refining of paraffin and paraffin oils.

Sulphur Estimation in Cast-Iron by Mr. A. H. Elliott's Method.—Will the author of this method kindly state whether he has compared the results obtained by this method with the results obtained by any other method or methods (of course, on the same sample of cast-iron)? Also, has he used it for the estimation of sulphur in white irons or in steels containing a large amount of combined carbon? If he knows of any special precautions that have to be taken other than those already published, will he kindly state them? I and a friend have tried this method on white irons or steels, and find that all the sulphur is not evolved as H_2S. My friend fused the residue left in the flask, using every precaution, and obtained a precipitate with $BaCl_2$. In making an estimation of titanium in iron, by dissolving with dilute HCl, separating graphite and SiO_2 from the residue, fusing this residue (together with a small precipitate obtained from the iron solution by an alkaline acetate) with $KHSO_4$, dissolving in cold H_2O, adding a little Na_2SO_3 to reduce the persulphate of iron, and boiling the dilute solution, I have obtained a precipitate, along with the TiO_2, of a blackish brown colour, which proves to be V; is this V_2O_4? Would *all* the V in the residue be obtained in solution by the above treatment, and would it all be precipitated by boiling long enough? If titanic oxide be dissolved by strong HCl in the presence of NaF, will any titanium pass off as fluoride?—S. PETERS, Bay State Iron Works, South Boston, Massachusetts, U.S.

MEETINGS FOR THE WEEK.

MONDAY, Jan. 8th.—Royal Geographical, 8.30.
TUESDAY 9th.—Royal Institution, 3. Dr. Tyndall, "On Ice, Water, Vapour, and Air."
—— Civil Engineers, 8.
—— Photographic, 8.
WEDNESDAY, 10th.—Geological, 8.
THURSDAY, 11th.—Royal, 8.30.
—— Chemical, 8.
—— Royal Society Club, 6.
—— London Institution, 7 30.
FRIDAY, 12th, Astronomical, 8.
—— Quekett Microscopical Club, 8.

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THE

MANUFACTURE OF CHLORINE.

ALTHOUGH the development of the process for the Manufacture of Chlorine by means of oxides of manganese regenerated by means of magnesia, to which reference was made on this page some months ago, has been sorely delayed by serious ill-health on my part, I am nevertheless in a position to announce that that process, in a certain modified form which it has now assumed, has proved capable of yielding even more advantageous results than I formerly claimed for it. It will necessarily be yet some time before I can be able or free to supply working details. Meanwhile, I beg to report as follows:—

I. That the new form of process yields, in the free state, practically *all* the chlorine contained in the salt decomposed, being at about the rate of *a ton of bleaching-powder per fourteen hundredweights of salt.*

II. That, of the chlorine which it thus yields, a sufficient proportion to give a ton of bleaching-powder for about each thirty hundredweights of salt is ENTIRELY UNDILUTED, and therefore available for the manufacture of bleaching-powder in the chambers at present in use. This portion of the chlorine is generated in the ordinary (Weldon) stills, and is in precisely the same condition as that produced in my process as at present practised, or as that generated by means of native manganese.

III. That, while the remainder of the chlorine is *dilute*, it is not more so than that produced in any process yielding dilute chlorine only, and is free from carbonic acid, the sole diluent being nitrogen.

IV. That the process, in its new shape, is performed without blowing engines, and *without machinery of any kind*, by appliances already in use in every alkali-work, the only thing employed in it which has any "moving parts" being an ordinary liquor-pump.

The new form of process thus yields more *strong* chlorine, per given quantity of salt, than has ever hitherto been produced by any process whatever, and, in addition, yields the remainder of the chlorine in as good a state as the richest chlorine producible by any process which yields dilute chlorine only. While permitting the present production of bleaching-powder, per given quantity of salt, to be nearly *quadrupled*, it enables one-half of the quadrupled production to be made from undiluted chlorine, in such chambers as have been employed hitherto, and one-half of the chlorine to be generated in the present stills. Putting the whole cost of the process on the *strong* chlorine only, the cost of the latter, per ton of bleaching-powder, promises to be lower than it has ever been yet, the other half of the chlorine counting as not costing at all. Lastly, the special plant required for the new form of process is so simple and inexpensive, that the cost of a plant for any considerable production will probably not exceed £20 for each ton of bleaching-powder to be made by it per week.

WALTER WELDON.

OFFICES OF WELDON'S CHLORINE PROCESSES COMPANY, (LIMITED),
59, LINCOLN'S INN FIELDS, LONDON, W.C.

December 12th, 1871.

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THE CHEMICAL NEWS.

VOL. XXV. No. 633.

THE ATTAINMENT OF UNIFORMITY IN BESSEMER STEEL.*

By Dr. THOMAS M. DROWN.

THE means relied on to attain uniformity in Bessemer steel may be enumerated as follows:—

(1). The appearance of the flame.
(2). The appearance of the slag.
(3). The spectrum of the flame.
(4). Examination of the steel itself.

At present I wish briefly to bring forward a few considerations with reference to the last two mentioned, namely—the conditions favouring the employment of the spectroscope and examination of the steel.

From the amount of careful investigation which has been devoted to the examination of the Bessemer flame by the spectroscope, both on the part of scientists and practical metallurgists, one might reasonably expect some results definite and satisfactory in their nature, first, as regards the nature of the flame, and second, as to the practical value of the spectroscope as a guide in conducting the process. We find, in fact, however, that uncertainty and confusion still exist. In Germany, where this subject has received the greatest attention, it is now very generally conceded that manganese is the cause of the well-known groups of dark bands that characterise the Bessemer spectrum. Nor is it easy to see how we can avoid accepting this conclusion, when Wedding and Von Lichtenfels have produced the manganese spectrum and found it to correspond closely with that shown by the Bessemer flame.

But it is evident, on a moment's reflection, as Roscoe has recently brought forward, that manganese cannot be the only cause of the Bessemer spectrum, for we notice the characteristic bands quite as plainly when English pig-iron is blown, which does not, at the beginning of the operation contain as much manganese as the German pig-iron does when the blow is completed, and the dark bands have completely disappeared from the spectrum.

Roscoe considers the bands to be due to carbon, which is known under different circumstances to present different spectra. Whatever may be the truth of the matter, one thing is certain, that the disappearance of the lines from the spectrum is coincident or nearly so, with the disappearance of carbon from the iron.

The question of the practical use of the spectroscope in the Bessemer process is, however, fortunately independent of any theory that we may hold regarding the causation of the spectrum, although we must admit that the idea of the lines being caused by carbon or carbonic oxide, the disappearance of which from the spectrum, coincides with the disappearance of carbon from the iron, has in it something attractive, affording, as it does, a common standpoint for theory and practice.

It is solely to the practical side of the question that I wish to draw attention now, and endeavour to reconcile, if possible, the conflicting statements made regarding the value of the spectroscope as a guide for stopping the blow.

The clue to the difficulty is to be found, I think, in the fact that the reports from Germany are almost unanimous as regards the practical advantages to be derived from the use of the spectroscope, whereas in England it is looked upon mainly as an instrument of scientific interest, which although it indicates promptly when to stop blowing, yet is no more accurate in its indications than is the flame itself to the unaided eye of an experienced workman.

The most emphatic endorsement of spectroscopic observations of the Bessemer flame that we have noticed from England are the statements of Mr. Snelus of Dowlais and Mr. Bragge of Sheffield, both quoted by Mr. Roscoe in his paper on "Spectrum Analysis" recently read before the Iron and Steel Institute of England.

"Mr. Snelus has informed me," writes Mr. Roscoe, "of the result of a series of experiments which go to prove what appears to me to be a very important point, and that is this—not only does he agree with me in finding that the point of decarbonisation can be accurately reached by means of the spectroscope, but he believes that it is also possible at the beginning, or in the course of the blow, to predict how long the blow will last—that is to say, he predicts in the middle of a blow, that the blow is going to last, say, for 18 minutes; and he finds that it does actually last 18 minutes. He then predicts, in in another case, 24 to 25 minutes; and he finds that it really lasted 23¼ minutes. He then predicts 32 minutes in another blow, and finds that it did take 32, and so on through thirty experiments, which were made both at Dowlais and Ebbw Vale."

When we consider that a few seconds more or less blowing materially affects the character of the steel produced, the practical advantage of the use of the spectroscope cannot be said to have received much support from these experiments, although in themselves of interest and value. The report of Mr. Bragge, also quoted by Mr. Roscoe, is to the effect that the spectroscope is daily used in the Atlas Works for determining the point of the disappearance of the carbon, and that, to a certain extent, they are satisfied with the result, especially in the case of new metal.

In Germany, on the other hand, as is well known, there are many Bessemer works where the spectroscope is relied on exclusively for stopping the blow. So plain are its indications found, that in Zwickau in Saxony, or instance, it is used by uneducated workmen with complete success.

That there must be a cause for the difference of opinion existing in England and Germany on this subject, independent of the love of the Germans for scientific research in practical matters on the one hand, and the excessive conservatism of the English in established manufactures on the other, must be conceded; for the practical failure of the spectroscope to aid the Bessemer process in England is the result of fair trial by scientific and practical men.

When one first observes the Bessemer practice in Germany, after being familiar with the English method, he is struck by the fact that the duration of the blow is much longer, as a rule, and the heat of the charge much greater.

The cause of the greater duration of the blow must be either that there is more to oxidise in the German pig-iron than in the English or that the rate of oxidation is slower. By comparing the two pig-irons we find that the English usually contains more silicon, the German more manganese, and also, as a rule, slightly more carbon, but the difference is not sufficiently great to account for any marked difference in the duration of the blows.

We must look for the cause, then, in a diminished rapidity of oxidation, which is dependent on the pressure of air and the number and diameter of the tuyeres. The pressure employed is very generally the same in all countries, as the height of the iron in the converter is generally uniform, but the number of tuyeres employed is very variable.

I regret that I have not been able to collect more data on the subject, but the following examples will, nevertheless, show clearly the difference of the English and German practice in this respect:—

* A paper read before the American Institute of Mining Engineers.

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	Capacity converter.	No. of tuyere holes.	Diameter.	Total area, in sq. in.
Konigshütte ..	3	49	¼ in.	2·40
Neuberg.. ..	3	49	⅛ ,,	4·27
Zwickau.. ..	3	42	⅜ ,,	5·12
Heft	2	42	¼ ,,	3·66
Crewe	5	144	⅜ ,,	15·59
Dowlais	5	156	⅜ ,,	17·22

If we reduce the number of square inches in each instance to the standard of 1 ton capacity, we have for

Königshütte	0·80
Neuberg	1·43
Zwickau	1·71
Heft	1·83
Crewe	3·18
Dowlais	3·44

At Harrisburg and Troy, we have 120 tuyere-holes of ⅜ in. in 5-ton converters, making a total area of 13·25 square inches, or 2·65 per ton capacity, which is about a mean between the German and English practice.

From these examples it will be seen that the relative amount of air forced into the converter in England is nearly double what it is in Germany, and we can thus see why it is that the duration of the blow should be so much longer in the latter country. What may have been the original cause of the adoption of a smaller number of tuyeres in Germany I do not know, but that this fact has an important bearing on the use of the spectroscope will be evident on a moment's consideration. The spectroscopic indication of the complete decarbonisation of the iron is the disappearance of the characteristic lines from the spectrum. If, in the last stage of the process, the oxidation of the carbon is effected very rapidly, as in England, the disappearance of these lines may be almost instantaneous, and afford no better indication to the conclusion of the blow than the dropping of the flame, with which it is coincident. If, on the contrary, the oxidation proceeds comparatively slowly, as in Germany, the lines fade away gradually, and it is from the degree of distinctness of the lines that the degree of decarbonisation is judged.

It requires but comparatively little experience to enable one to estimate, with very great nicety, the extent of the decarbonisation by the degree of distinctness of the characteristic bands in the spectrum. Although a practised eye will often unaided be as correct in its decision as one provided with a spectroscope, yet, in the long run, there can be no doubt that greater accuracy and simplicity of working is attained by relying exclusively on the indications of the spectrum, provided that the rate of oxidation is not too rapid.

The employment of an excessive number of tuyeres prevents, too, the nice adjustment of the amount of air to the amount of carbon and silicon towards the end of the process. It is readily conceivable that when the amount of these elements remaining is very small, that they may not be able to preserve the iron from oxidation in presence of a large amount of air.

Whether the heat of the charge has anything to do with the reliability of the spectroscopic indications cannot be definitely stated, but it seems reasonable to suppose that the higher the temperature the more satisfactory the observations will be. The only evidence bearing on this point is from Bleichsteiner of the Maximillian's Hütte in Bavaria, who has observed that with hot charges, with much smoke, which accompanies highly manganiferous pig-iron, the Bessemer spectrum disappeared before the complete decarbonisation of the iron had taken place, whereas with cold and non-smoking charges the disappearance of the spectrum and complete decarbonisation were coincident.

I have already mentioned the fact, which I think, will be generally admitted by those conversant with the subject, that the heat of the charge is, as a rule, greater in the German practice than in the English. This fact I have noticed particularly at Zwickau, where the flame in the last stage of the blow is so intensely bright that coloured glasses are almost indispensable to protect the eyes. The cause of the higher temperature attained in Germany is somewhat obscure.

In general, the sources of heat in the Bessemer process may be enumerated as:

(1). The initial heat of the metal in the converter, which depends on the temperature of the pig-iron as it flows from the cupola, and the temperature of the converter.

(2). The heat resulting from oxidation of the silicon, which is equal, according to Jordan, to 6382·4 units for every kilogramme oxidised by atmospheric air to silicic acid.

(3). The oxidation of iron, equal to 757 units per kilogramme of iron oxidised to protoxide.

(4). The oxidation of manganese to protoxide, equal, according to Jordan, probably to the same amount as in case of iron.

(5). The oxidation of carbon to carbonic oxide, in which case only 475·2 units are available in the process per kilogramme of carbon.

The main source of the increase of heat during the process is due, therefore, to the oxidation of silicon, which is much more largely present in English pig than in the German. Not much influence can be attributed to the manganese, as it merely replaces iron in the slag, and as we have assumed the thermic effects of the oxidation of manganese and iron to be equal.

I have thought that it might be possible in those instances where the English practice is followed of blowing with a large number of tuyeres, that some air might pass through without having all its oxygen absorbed. When we consider that the depth of iron in the converter would be only 12 to 14 inches in height, were it in a state of rest, and that it is tossed about by a current of air with such violence as to be often ejected in part from the mouth of the converter, such a condition of affairs seems not improbable. If it is ever actually the case, a loss of heat would, of course, be the consequence.

The only experiments which bear on this point, as far as I know, namely those of Snelus of Dowlais, do not, however, support this view. He examined the gases evolved from the converter during a blow of 18 minutes at 2, 4, 6, 10, and 12 minutes after the commencement, and found no free oxygen present, showing that it had been completely absorbed.

But as the experiment was not tried primarily with a view of determining this point, it may be that the conditions with reference to pressure and amount of blast were not as we have supposed.

The more rapidly the oxidation proceeds, other things being equal, the higher, of course, will be the resulting temperature. If it should be proved, therefore, that the limit of tuyere area has not been exceeded, and that the oxygen of the blast is completely absorbed even in the extreme cases which have been mentioned, then the English practice of blowing ought to be more favourable to the production of a high temperature than the German.

Apart from these considerations, it is undeniably true, that there are many great advantages resulting from a very high temperature in the converter, one of the most important of which is the opportunity afforded for testing the steel before casting. In spite of accumulated experience gained in conducting the Bessemer process, in spite, moreover, of the great assistance we may derive from the use of the spectroscope, it must, nevertheless, be admitted that absolute certainty with regard to the quality to the steel produced can only be gained by examining the steel itself.

In Zwickau, where the process is performed without the usual addition of spiegeleisen or other form of pig-iron,

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the blow is suspended when the spectrum indicates that the decarbonisation is sufficiently complete. A long rod of iron is then inserted into the converter, to which a quantity of slag adheres, through which are dispersed beads of metal. The rod, after removal, is at once plunged into water and allowed to remain till cold. The metallic beads are then separated from the slag and tested by hammering as to their hardness and malleability. According as the result of this test is satisfactory or otherwise, the steel is poured into the ladle, when sufficiently cool, or the converter is turned up again and the blast continued for a second or two longer. By this system perfect uniformity of product is obtained.

That this result is rendered possible by having a temperature in the converter much higher than is simply necessary for casting, shows the practical value of high heats. Whether the advantage of uniformity of product would be considered more than counterbalanced by the shorter duration of the converter lining, is a matter to be determined from an economical standpoint, which it is not my purpose at present to discuss.—*Engineering and Mining Journal.*

SEWAGE AS A FERTILISER OF LAND, AND LAND AS A PURIFIER OF SEWAGE.*

By J. BAILEY DENTON, C.E., F.G.S.,
Hon. Member of the Royal Agricultural Societies of Norway, Sweden, and Hanover.

(Concluded from p. 9).

III. *Separation of the Excretal Closet-matter from the Liquid Refuse of the Sewer, and dealing with each separately.*

As already stated, the treatment of the excremental contents of the closet separately from the liquid sewage of the sewers, is an object in which agriculturists must take a very great interest, though I have never yet met with any estimate of their value. Reverting, however, to the figures given as the value of the voidings of human beings, it would not be too much to take a fifth of the intrinsic value quoted (8s. 5¾d.), or 1s. 8¼d. per head of the population, as the value of that which is retained in the closet, and which is capable of separate treatment, and is easy of removal to lands which cannot partake of the liquid sewage.

As the subject of this paper is limited to the fertilising powers of sewage and the purifying powers of soil, it forms no part of my purpose to discuss the question whether town authorities act wisely in maintaining such a species of scavenging as is involved in the removal of the excretal refuse apart from the liquid sewage. I am however, prepared to state that, having examined several dry processes now in use, there are some that may be adopted without objection, though it cannot be expected that the occupiers of superior houses who have once enjoyed the comfort of well-supplied and well-constructed water-closets should abandon the advantage and resort to dry closets of any description. At Rochdale, Alderman Taylor has patented a plan which is now in use there. Beneath each seat a receptacle containing a small quantity of a disinfecting fluid is placed, in which the fæces and urine are collected. The receptacles are removed in a covered cart weekly, or more frequently if required, to a manufactory on the outskirts of the town. There they are mixed with fine ash reduced from the cinders and dry refuse collected from the houses. The larger cinders, when separated from the ash, are sold. The average price realised for the manure mixture has been 17s. per ton, affording a profit, after deducting all expenses, of 2s. 5d. per ton. At the price mentioned, the manure is readily sold, and I can well believe is of great value to the farmer, particularly for certain descriptions of grass lands.

In large manufacturing towns, where water is much required in the trade that supports the population, and where it is desirable to economise as much as possible its use, and therefore to avoid water-closets, Alderman Taylor's process has much to recommend it, and from personal observation I am able to declare that it is free from the many objections that attend badly-constructed and badly-managed water-closets. In fact, I examined many closets attached to cottages in Rochdale which were much more creditable than many of the water-closets attached to large establishments in the metropolis.

But whatever may be done with the excretal matter by dry appliances, it will not be possible to avoid the proper disposal of the sewage of the sewers, and that will still have to be done by one of the classes of treatment already explained.

In small towns and villages it is still to be hoped that the dry-earth system, invented by the Rev. Henry Moule, may be more generally adopted. The experience gained, however, shows that the frequency with which the closets get out of order, and the difficulty of supplying and removing the earth is such that, unless a system of management is organised and enforced, they cannot gain much ground.* Where there exists a proper officer, with assistants, if necessary, to supply the earth and remove the soil, and to keep the closets in working order, it is impossible that anything can be more suitable for isolated establishments and country villages; and when it is remembered that the difficulties of providing a public supply of water to villages are such as to be insurmountable in many cases, and that the leaky condition of the privy and cesspit maintains the soil in close villages in an excrement-sodden condition, resulting in the pollution of tank or well water, it does appear almost incomprehensible that the governing powers of this country should permit the continuance of the present state of things.

Land as a Purifier of Sewage.

Having spoken of the general purification of sewage by land, when treating of irrigation and filtration, it is only necessary to add a brief description of the process of intermittent filtration, as it has been carried out under my directions at Merthyr-Tydfil. There 20 acres of land have been laid out for the purification of the sewage of the district, of which the dry weather flow at the time when the works were commenced amounted to 870,430 gallons per diem, the least flow during the day being 500 gallons; and the greatest 663 gallons a minute. The population contributing this sewage exceeds 50,000, but at present less than half the houses are connected with the sewers so that the sewage may be taken as equivalent to the discharge of about 30,000 people. The number of water-closets being few, the sewage may be considered to be weak. Upon occasions of rainfall (which is above the average), the flow of the sewers is much increased, the storm waters frequently raising the discharge at least 50 per cent above the ordinary dry weather flow, and this excess finds its way to the filtering areas. The 20 acres of land were divided into four equal parts, and before forming the surface to receive the sewage the whole was drained from 5½ to 7½ feet deep, and deeply cultivated. By this means 2 cubic yards of soil for every square yard of surface became serviceable as filtering material, there being but very few rods of ground in which the full depth of 6 feet was not secured. The quantity of filtering material was fixed upon so that the maximum quantity of sewage which

* Read before the Society of Arts, December 6, 1871.

* For description of a means of dealing with slop and scullery refuse by Field's self-acting syphon, see "Village Sanitary Economy," in the *Journal of the Royal Agricultural Society*, vol. iv., s.s. part 1.

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would at any time have to pass through each cubic yard of soil would not exceed 7¼ gallons per diem, while the mean quantity of dry weather sewage would pass through at the rate of 5 gallons per cubic yard. The under-drainage was so designed that no sewage could travel over the surface directly above the drain, which is the case in instances of irrigation of free soils in which the results have not been so favourable.

Here the result has been the most complete purification of the sewage up to this time, and the realisation of the fact that the effluent water from the under-drains was as pure when the whole of the sewage was passing through half the filtering areas, viz., 10 acres, as when it passed through 15 and 20 acres, showing clearly that a less number of acres than 20 acres would suffice for the purification of the quantity of sewage dealt with, and that, therefore, if the sewage had been double the strength or double the quantity, as it may ultimately be when the whole of the sewage of the 50,000 persons is discharged by the sewers, there will be a certainty of complete purification of the whole if the board manage the works efficiently now they are completed.

During the period when the existing sewage, increased at times by the rainfall, was discharged upon the 10 acres (half the areas), they were receiving as much as 144,000 gallons per acre, which is equal to a depth of nearly 6¼ inches, and never less than 72,000 per acre (equal to a depth of 3¼ inches).

Instead of following the mode of distribution usually adopted in sewage irrigation, when the fluid is either run over a regular surface, or along the ridge to flow over the slopes on either side, the surface of the Merthyr filtering areas was laid out in the ridge and furrow form, as before explained, the object being to allow of the use of the horse and hand hoe, and while growing crops on the ridge to allow the sewage to flow in the furrows, and rise up to the ridge sides with a certainty of being absorbed, and of feeding vegetation at the same time. This treatment has been so successful that, in spite of the deposit of the finer particles of floating matter in the furrow, the whole of the sewage has disappeared within four or five hours after application, and the land has acted as a purifier up to this time in such a way that the effluent water from the under drains is pronounced by Dr. Benjamin Paul to be cleaner than the Thames water above the intakes of the metropolis water companies. In order that its condition may be compared with the standard suggested by the Rivers Pollution Commissioners, I here give the analyses of the discharge from the 10 and 15 acres, when the whole of the sewage was run through those quantities of soil:—

Results of Analyses in parts per 100,000.

Solid contents—	Effluent water from 10 acres.	Effluent water, from 15 acres.
Total	39·000	55·000
Fixed	34·000	34·000
Volatile..	5·000	21·000
Ammonia	0·082	0·086
Organic matter ..	0·018	0·011

Though it is a subject of personal satisfaction to me to have been the first to test, by designed operations, the process of intermittent downward filtration, suggested by the Rivers Pollution Commissioners, and to prove by direct evidence that the objections they anticipated can be avoided, the result might have been expected from the circumstance that in every case where sewage has been utilised on land, and allowed to pass through the soil as well as over it, the effluent water has been perfectly satisfactory. This will be seen by the following analyses of effluent water discharged from lands which have absorbed the sewage without any overflow from the surface, and without being laid out for intermittent action, except in the case of Merthyr Tydfil which I have described.

Parts per 100,000.

Date.	Place.	Total Solid Matter in solution.	Organic Carbon.	Organic Nitrogen.	Ammonia.	Chemical authority.
1868						
Sept. 10	Bedford.. ..	76·80	0·575	0·163	0·023	Rivers Pollution Commissioners.
„ 23	Carlisle	28·80	0·591	0·204	0·025	„
„ 24	Penrith	21·90	0·320	0·108	0·001	„
1870						
July 9	Convalescent Hospital, Walton	10·87	—	0·002	0·002	Dr. Odling.
July 24	Breton's Farm, Romford	70·60	—	0·037	0·003	Dr. Russell.
1871						
Sept. 4	Merthyr-Tydfil	39·00	—	0·018	0·082	Dr. Benj. Paul.
„ 4	Lodge Farm, Barking	91·30	0·676	0·198	0·005	Dr. Frankland
„ 12	Tunbr. Wells	34·44	—	0·060	0·030	Dr. Voelcker.

If the proportions of polluting matter indicated in these analyses are compared with those contained in the effluent liquid discharged from the chemical processes to which reference has been made, or even with those of the effluents from the surface of lands over which sewage has been passed, the superiority of the combined effect of filtration associated with irrigation must be acknowledged. And on a study of all the facts such comparisons will expose, it will be manifest to every unprejudiced mind that not only is it possible for town authorities to conform to a high standard of purity, but that, with a comparatively small quantity of land at command, it is a simple and inexpensive thing to do.

If this be true, ought there to be any hesitation in adopting a standard so high as to remove all doubt on the subject, with compulsory powers to enforce it?

We have had mournful proof that polluted water will find its way into the palace of the powerful as well as into the cottage of the poor; and our Society has special reasons, in the very serious illness of our Royal President, the Prince of Wales, which has aroused the anxiety of the whole nation, and which is said to be traceable to impure water or sewer gases, for exerting all the power it possesses in preventing the public interests being sacrificed to the influence of water companies, and the false notions of economy which prevail with Local Boards of Health.

EXAMPLES FOR PRACTICE IN QUANTITATIVE ANALYSIS.

By ALEXIS A. JULIEN,

Assistant in charge of the Quantitative Laboratory of the School of Mines, Columbia College.

(Continued from vol. xxiv., p. 295).

Example No. 11.—*Proximate Analysis of Coal.*

Pulverise sufficiently fine to pass through a sieve of 100 holes to the linear inch.

(*a*). Weigh out 1 grm. of coal in a half-ounce platinum crucible, heat fifteen minutes in an air-bath at 115° C., cool, and weigh. Repeat the operation at intervals of ten minutes in the air-bath, until the weight becomes constant or begins to rise. The loss, obtained from the lowest weight, is equivalent to the moisture. But if the coal is an anthracite, or if, by a preliminary experiment, it has been ascertained that more than an hour is necessary to obtain the lowest weight, much longer intervals may be substituted for those given above.

Immediately heat the same crucible, covered closely, to bright redness over a Bunsen burner for exactly three and a half minutes; and then (without cooling or moving the crucible) to a white-heat over a blast-lamp, for three and a half minutes; cool, and weigh. The loss is equivalent to the volatile and combustible matter, including

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one-half of the sulphur of the FeS_2 which the coal may contain. Repeat the operation on another grm. of coal (previously removing the moisture), and if the results agree within one-tenth of a per cent, take the mean.

Remove the cover, incline the crucible, and ignite over a Bunsen burner until all the carbon is burned off, as determined by the colour of the ash and the constant weight. The loss is equivalent to the fixed carbon, and the weight of the last residue is that of the ash. The latter may also be directly determined by igniting another portion of the original coal in an open platinum capsule, previously weighed.

A qualitative examination of the ash for iron, sulphur, phosphorus, &c., is generally sufficient, but, if a quantitative is desired, it may be fused with Na_2CO_3 and then analysed as in Example No. 7.

(*b*). *Determination of* S *and* P.

Put 2 to 5 grms. in a covered vessel of the capacity of at least one litre; add about 100 c.c. of conc. HNO_3 (sp. gr. about 1·3), and 5 grms. of powdered $KClO_3$; and heat to boiling, replacing the HNO_3 as it evaporates, and adding lumps of $KClO_3$ from time to time (to keep the vessel full of chlorine) until all the carbon is oxidised. Transfer to an evaporating dish, evaporate to dryness to separate the SiO_2, moisten with HCl, dilute, filter, and wash, heat the filtrate to boiling, add $BaCl_2$ in excess, and determine the S as $BaSO_4$ in the usual way, thoroughly purifying it after ignition.

To determine the P in the coal, unite the filtrate and washings from the $BaSO_4$ obtained above, heat to boiling, add $(NH_4)_2O$ in excess, filter rapidly, wash once, dissolve in HNO_3, and precipitate the P with ammonic molybdate. Or twice as much coal may be dissolved at first, the HNO_3 solution divided, and the P precipitated directly in one-half.

The coal may also be decomposed by the following method. Mix 2 grms. thoroughly with 16 grms of Na_2CO_3, and 16 grms. of Na_2NO_3, all in fine powder. Deflagrate in a covered two-ounce platinum crucible; cool, dissolve in water, and remove the crucible; acidulate; transfer to evaporating dish, and proceed as above.

(*c*). *Determination of Specific Gravity*.—Pulverise to small fragments which will just pass through a sieve of 30 holes to the linear inch, and free from any finer powder. Introduce into a flask with tubulated stopper, allow to soak in distilled water for 12 hours, and determine the specific gravity in the usual manner.

EXAMPLE No. 12.—*Determination of Nickel in Ores.*

Digest from 3 to 5 grms. of finely powdered ore with 20 c.c. H_2SO_4, 10 c.c. HNO_3, and 5 c.c. HCl. Evaporate to dryness, expelling the excess of H_2SO_4, cool, moisten with HCl, add hot water, filter, and wash. Saturate the diluted filtrate with H_2S gas, filter out the sulphides of copper, lead, &c., and wash with H_2S water. Boil the filtrate with a little HNO, add Na_2CO_3 almost to neutralisation, and precipitate the Fe_2O_3 and Al_2O_3 as basic acetates, as in the analysis of iron ore, filter, and wash. Dissolve the basic acetates in HCl, and repeat the precipitation, filtration, and washing, to separate a little NI at first carried down. Unite and concentrate all the filtrates and washings, and add $(NH_4)_2O$ in excess. If a little Fe_2O_3 separates, filter, wash twice, dissolve in HCl, re-precipitate with $(NH_4)_2O$, filter, wash, and add the filtrate to the main solution. Boil, add a boiling solution of NaS in excess, acidulate with acetic acid, allow to settle, filter, wash the NiS with H_2S water, remove the moist precipitate as completely as possible to an evaporating dish, dry and burn the filter; dry and roast the precipitate in the dish, and add the ashes of the filter. Dissolve the whole in a little aqua regia, evaporate the free acid almost entirely, dissolve in hot water, boil, add pure solution of KHO in slight excess, heat for some time nearly to ebullition, decant upon a filter three or four times, boiling up each time, filter, wash thoroughly with hot water, dry, ignite, and weigh. Carefully examine the residue for KO, SiO_2, Fe_2O_3, and Al_2O_3, and CoO. Result—NiO + CoO.

In American ores, the metal in this residue rarely exceeds 1 per cent of the original ore, and the Co is seldom separated; but, if desired, the following method may be employed:—

Dissolve the residue in a few drops of HNO_3, and neutralise the excess of free acid with a few drops of KHO. Then add a concentrated solution of KNO_2 (previously neutralised with acetic acid and filtered from any flocks of SiO_2 and Al_2O_2 that may have separated) in sufficient quantity, and finally acetic acid, till any flocculent precipitate that may have formed from excess of KHO has re-dissolved and the fluid is decidedly acid. Allow it to stand at least for 24 hours in a warm place, take out a portion of the supernatant fluid with a pipette, mix it with more KNO_2, and observe whether a further precipitation takes place in this after long standing. If so, return it to the principal solution, add more KNO_2, and repeat the test after long standing. Filter, wash thoroughly with an aqueous solution of neutral potassic acetate (containing 10 per cent of the salt), and finally with spirit of wine of 80 per cent. Dry, ignite, incinerate the filter, moisten the whole with H_2SO_4, and drive off the excess and weigh. Result—$2CoSO_4 + 3KSO_4$.

EXAMPLE No. 13.—*Determination of Zn in Blende.*

Treat 2 grms. of finely-powdered ore with 10 c.c. HCl, 5 c.c. HNO_3, and 5 c.c. H_2SO_4. Evaporate to dryness, and heat for some time after the fumes of H_2SO_4 have ceased. Treat with hot water, filter, and wash. Add 20 c.c. of HCl to the filtrate, saturate with H_2S gas, filter rapidly on a covered funnel, and wash with H_2S water. If the precipitate is bulky, dry, roast, dissolve in a little aqua regia (A, β), evaporate nearly to dryness, add water and HCl, saturate again with H_2S gas, and filter and wash as above. Unite all these filtrates and washings containing Zn, add Na_2CO_3 almost to neutralisation, and separate the Fe_2O_3 and Al_2O_3 as basic acetates. Redissolve and re-precipitate this precipitate, to obtain the portion of Zn at first carried down. Unite the filtrates and washings, acidulate with acetic acid, saturate with H_2S gas, filter, and wash with H_2S water. Treat with HCl, add a little $KClO_3$, boil, and filter into a capacious dish. Add solution of Na_2CO_3 in slight excess, boil a few minutes, allow to subside, decant upon a filter, wash by decantation several times, transfer to the filter, wash thoroughly, dry, remove as completely as possible from the filter, burn the filter on the lid, ignite, and weigh. Examine the residue for NaO, Fe_2O_3, and Al_2O_3. and SiO_2. Result—ZnO.

CORRECTION.—In the CHEMICAL NEWS, vol. xxiv., p. 294, Note 18, for "Put solution (d_2) directly into," read "Expel HNO_3 from solution (d_2) by evaporation with an excess of H_2SO_4, and place in."

(To be continued).

FIBRIN: ITS ORIGIN AND SOURCES OF DEVELOPMENT IN THE ANIMAL ORGANISM;

VERITABLE FIBRIN BEING PROVED TO BE DERIVED FROM ALBUMINOUS SUBSTANCES BY THE AGENCY OF WATER.

By JOHN GOODMAN, M.D., &c.

(Concluded from p. 6).

OTHER MODES BY WHICH FIBRIN IS SAID TO HAVE BEEN PRODUCED.

I FIND that many physiologists who have been reputed to have produced fibrin by other agencies have done so out of dilute solutions, that is, under the influence and agency of water.

Thus Müller produced coagulated fibrin out of clear,

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filtered, and consequently defibrinated, blood serum. This experiment is graphic of what we have witnessed again and again in these researches. "But," says he, "the blood was diluted with water or with a very thin syrup, 1 part sugar in 200 water." In a few minutes a coagulum formed in the clear liquid after it had passed the filter. But, even then, "this coagulum could not be detected save by drawing it out of the fluid by a needle." "This," says he, "gradually (after a few minutes) contracts, becomes whitish and fibrous, and then has exactly the aspect of human lymph." As regards the admixture of two (diseased) serous fluids, such as those of hydrocele and ascites, or ascites and pleurisy, as suggested by Dr. Buchanan,* these could take no part in the mode of transformation of albumen into fibrin, in the absorbments, &c., and are therefore foreign to our present subject.

Finally, as regards the renowned experiment of Prof. Schmidt, who is declared by Dr. Carpenter to have attempted to explain the phenomena in question (p. 242), by attributing them to the combination of two substances, existing in the liquor sanguinis, which he has denominated "globulin" and "fibrinogen." That such substances really do always exist in the serum or liquor sanguinis, without Prof. Schmidt's interference, is not quite certain, any more than that of Mulder's favourite idea of protein existing ready formed in all nitrogenous substances as their primary and basic compound. However, Dr. Carpenter goes on to say, "Both Schmidt and Hoppe Seyler have been successful in producing a coagulum differing in no respect from ordinary fibrin, by the admixture of these two substances." One might have some difficulty and trepidation in assailing such an explanation of the origin of fibrin in the animal organism as the above, and by so eminent a physiologist, were it not for the great uncertainty that attends all speculations upon matters formed out of the body by chemical decomposition. But when we read on a little further, that both these compounds were precipitated by carbonic acid from dilute solutions, all difficulty is at an end. A good deal of water must have been employed, and, according to the facts of this paper, the *rationale* is obvious.

It is thus seen that many physiologists, in experimenting upon, and endeavouring to discover the origin and source of, fibrin in the animal organism, whilst employing other measures which they have supposed capable of effecting this transformation, have been unsuspectingly making use of the very agent which alone is capable of developing this important product.

It is rather remarkable how much the illustrious Liebig insists upon the necessity for the presence of water, before oxygen can effect any change in organic substances. ("Organic Chemistry," pp. 111 and 225).

Müller, in his work on Physiology (p. 294), declares that when frogs have been kept out of water for eight or more days, during the summer, their blood often loses the power of coagulation, and, under such circumstances, the lymph taken from the lymph cavities of the same animal affords no coagulum.

Fibrin is formed, therefore, as shown by Dr. Carpenter and other physiologists, in the lymphatics, lacteals, absorbent and mesenteric glands, and vascular system,† and we maintain, from the foregoing facts, that this transformation is effected by the agency of water. That water is drawn from the sanguineous circulation—the great cavities of the body, &c., and from the skin—is admitted by all physiologists, while at the same time the liquor sanguinis and albuminous substances are brought up from the blood-vessels and from the parenchyma of other organs, the latter in the shape of effete matters and used-up materials, which, as Dr. Carpenter says, are capable of being again assimilated; that these, on meeting with the aqueous fluids, begin at once to undergo a change, and that change is the transformation from albumen to fibrin, which he represents as the being subjected to an elaborating or preparatory agency previous to their introduction again into the circulation. This elaboration he speaks of again as being the formation of fibrin, the assumption of coagulation, and the appearance of a number of chyle or cytoid corpuscles. This process Dr. Prout speaks of as "a sort of digestion carried on in all parts of the body.

We observe, likewise, that the aliment itself is exposed to the action of water, in the shape of all fluids that enter the alimentary canal by imbibition, and afterwards the venous blood in the liver and vena cava is also subject to an influx of water, which is drawn from the stomach by the gastric veins.

Here, then, is the admitted presence of the transforming agent at the very point or locality—*i. e.*, in the lymphatic vessels and glands—where the presence of fibrin is first detected. The existing estimated amount, therefore, of this fluid in the lacteals and lymphatics, in comparison with the amount of existing albumen, and, at the same time, in comparison with the relative quantities of water and albumen in the blood, becomes an important subject of enquiry in this place.

According to Von Gorup-Besanez (Dr. Carpenter's "Physiology," p. 56), we have in 1000 parts of—

Lymph	albumen	24·6
Chyle	,,	40·9
Blood	,,	195·6

thus giving eight times as much water present in lymph, and five times as much in chyle, to 1 part of albumen, as is present in the blood.

According to Gubler and Quevenne, quoted by Dr. Carpenter (p. 178), we have in 1000 parts—

	Water.	Albumen.
Lymph	939·87	42·75
Chyle	904·80	70·80
Blood	796·93	58·82

thus presenting nearly 22 parts of water to 1 of albumen in lymph,—to 13½ water to 1 of albumen in the blood. In the chyle we have a higher amount of albumen in man, though not in animals, so it is stated, to the existing amount of water. But it must be remembered that this fluid had not as yet joined the lymph, being drawn for examination before it reached the receptaculum chyli, in which the lymph unites with the chyle. Nor had it either been subjected to the action of the imbibed fluids from the gastric veins, to which it is, at least for a short time, exposed after its entrance into the sanguineous circulation.

Finally, in corroboration of the facts herein adduced, how powerfully expressive is the fact that, in embryonic life, the fœtus is found to exist in an aqueous fluid, the liquor amnii, the composition of which is declared to be only 7 parts of albumen in 1000 parts of liquid,—a fluid to which both the alimentary canal and absorbent system through the skin have a free and constant access.

If water, therefore, is capable of producing with such facility the change in question,—if this change is, as we have seen, incapable of being effected without the presence of water,—and if this fluid is also discovered to be present in the lymphatics and absorbent glands, where fibrin is first and chiefly discovered to receive its origin, and that in an amount ample and sufficient to meet every requirement of the organism,—unless some more probable cause can be discovered, we shall, of course, be under the necessity of admitting water to be the producing cause of this phenomenon.

We have in possession several specimens of this product preserved in spirit, which could not be distinguished from blood fibrin; others, the result of exposure to oxygen, to the voltaic current, and also of precipitation, which present incontrovertible evidence of the facts herein adduced.

* Dr. Carpenter's "Physiology," p. 242.
† *Ibid.*, pp 179, 180.

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CHIEF CHEMICAL EXPERIMENTAL PROOFS.

Solution in Liquor Potassæ, cold.

Expt. 9.

Nov. 15. Fibrin *ab* albumen completely disappeared, or dissolved, in liq. potassæ, in about 3 minutes.

Expt. 19,

Nov. 17. The experiment repeated. It dissolved completely in a few minutes, without change of colour.

N.B. Much depends upon the thin membrane-like nature or thickness of the substance operated upon, for speedy solution or otherwise.

Expt. 66.

Dec. 8. Blood fibrin submitted to liq. potassæ required 12 hours for its solution in the same liquid, cold. It became reddish-brown before its solution was effected.

In this experiment blood fibrin resembled albumen much more nearly than did fibrin *ab* albumen.

Expt. 67.

Nov. 16. Albumen, coagulated by heat from the egg, required 24 hours for its solution in liq. potassæ, in three experiments. When cut into thin shavings it was dissolved in 12 hours. In all instances it became brown or black, and blood-red when heat was applied in dissolving.

Solution in Strong Hydrochloric Acid, cold.

Expt. 52.

Dec. 8. Blood fibrin was placed in ditto.

Dec. 9. Both were quite dissolved, not a particle remaining; the liquid having assumed, in both instances, a dark green colour, in 24 hours.

Expts. 13, 14, 15.

Fibrin *ab* albumen, in ditto, dissolved in 14 hours.

Expt. 52.

Dec. 8. Fibrin *ab* albumen was placed in ditto, cold.

Expt. 53.

Dec. 14. Albumen coagulated by boiling, was placed in ditto, cold.

Dec. 15. Gas is being eliminated, the coagulum still undissolved.

Dec. 30. Still undissolved in 16 days. A portion must be dissolved, as the liquid is dark green. Probably some of the albumen is transformed into fibrin which would dissolve in 12 hours (see above).

Expt. 17.

Albumen, raw, ditto ditto, a portion quite undissolved in 23 days.

Expt. 52.

Dec. 30. Thin portions of coagulated albumen, in heated acid, became dissolved in less than 1 hour.

Solution in Dilute Hydrochloric Acid.

"Fibrin of muscle, after it has been well washed and pressed, to free it from soluble matters, is dissolved, more or less completely, by dilute hydrochloric acid, 1 part in 1000."—*Dr. Miller*, p. 808.

Expt. 10.

Nov. 16. Fibrin *ab* albumen, placed in dilute acid, 1 part in 10. The surface swelled up, and became semi-transparent for a given depth, as if about to dissolve. But it was not before Nov. 24th, or eight days afterwards, that its solution had taken place. Fluid dark green.

Nov. 16. "Blood fibrin placed in water mixed with $\frac{1}{10}$th of its bulk of acid, swells up slowly into a gelatinous mass; on addition of a stronger acid, shrinks to nearly its original volume, and again swells up when put into water, but it does not form a true solution."—*Dr. Miller*, part 3, p. 808.

Expt. 55.

Blood fibrin in ditto unchanged in 6 days.

Expt. 12.

Nov. 16. Raw egg albumen was placed in ditto, 1 part in 10. It eliminated gas, and became quite dissolved by Nov. 21st, or in 5 days. Fluid dark green.

PRECIPITATED SOLUTIONS UNDER THE MICROSCOPE.

Solutions in Liquor Potassæ, precipitated by Acetic Acid.

Expt. 78.

Jan. 7. Blood fibrin, in liq. potassæ, 3 drops, precipitated by acetic acid, 1 drop.

Result:—No coagulum. All fibrinous rods and formations adherent one to another. All transparent! In this and several other instances there were apparently coagula until each was brought into focus of the microscope, when they were seen as above.

Expt. 79.

Jan. 7. Fibrin *ab* albumen, in liq. potassæ, 3 drops, precipitated by acetic acid, 1 drop.

Result:—No coagulum. All fibrinous formations, like those of blood fibrin, resembling leaves of a tree, adherent together generally by a rod through the whole, or a rod for a stem, and sometimes rods for branches.

Expt. 80.

Nov. 17. Albumen, in liq. potassæ, 3 drops, precipitated by acetic acid, 1 drop.

Result:—White homogeneous flocculi, easily separable; an incoherent mass, more like inorganic substance, without formation. Not a single fibrinous rod.

Expt. 80 *repeated.*

Nov. 24. Repeated the same experiment with albumen.

Result:—Nothing but a cloudy or flocculent precipitate. No rod or other fibrinous formation!

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Solutions in Potash of Commerce, precipitated by Acetic Acid.

Expt. 33.

Nov. 30. Fibrin *ab* albumen, ditto, ditto.

Result:—Fibrinous rods in a clear liquid. No coagula.

Expt. 35.

Nov. 4. Coagulated ov-albumen, ditto, ditto.

Result:—A white cloudy and flocculent precipitate, mixed with crystals of acetate of potash. No rods. All coagula.

Solutions in Potash of Commerce, precipitated by Nitric Acid.

Expt. 33.

Nov. 30. Fibrin *ab* albumen, in ditto, ditto, precipitated by ditto.

Result:—Nothing observable of any moment but long fibrinous rods, some coiled, others straight or crooked, and for the most part transparent, not yellow.

Expt. 34.

Ov-albumen coagulated by heat, in ditto, ditto.

Result:—Flocculi or nebulæ of albumen, shapeless, homogeneous, and opaque, intermixed with crystals of nitrate of potash. Precipitate, lemon-yellow colour.

Solutions in Liquor Potassæ, precipitated by Nitric Acid.

Expt. 81.

Jan. 7. Blood fibrin. Solution 2 drops, acid ½ drop.

Results:—Exactly resembling those of fibrin *ab* albumen precipitated by acetic acid. No flocculi, but transparent formations like leaves of trees, with stems of fibrinous rods, and sometimes rods for branches, adherent and moving together in mass, evidently all possessing the same nature and character. Many rods. No lemon-yellow.

Expt. 82.

Fibrin *ab* albumen. Solution 3 drops, acid 1 drop.

Results:—No coagula. All transparent fibrinous formations, exactly resembling those of blood fibrin. No flocculi, no coagulum, many rods. No lemon-yellow precipitate.

Expt. 83.

Albumen. "Nitric acid with albumen, lemon-yellow precipitate."—*Dr. Miller*, part 3, page 801.

Results:—Much coagulum! No rods! Precipitate, lemon-yellow colour always.

N.B. When old solutions were employed there was much of the fibrinous character in the albuminous, and of the albuminous in the fibrinous, results.

Solutions in Strong Hydrochloric Acid, precipitated by Liquor Ammoniæ.

Expt. 57.

Dec. 10. Blood fibrin, in ditto, ditto.

Results:—Effervescence. A dense coagulum found to be crystals only, by microscope. Large pieces of organised formation intermingled with rods.

Expt. 58.

Fibrin ab albumen, in ditto, ditto.

Results:—Effervescence. A seemingly dense coagulum resolved into crystals, by microscope. Large pieces of organised fibrin, exactly similar to those of blood fibrin.

Expt. 59.

Dec. 12. Albumen, in ditto, ditto.

Results:—An old solution. Fibrinous rods, with dense flocculi.

Expt. 87.

Jan. 3. Ditto, ditto. In 2 or 3 minutes.

Results:—No coagulum. Fibrinous rods and thick bundles of fibrils. The solution is old; some coagula form afterwards.

Expt. 88.

Jan. 3. Ditto, ditto. In 2 or 3 minutes.

Results:—No coagulum. Very long and straight fibrinous rods. Old solution; some coagula afterwards.

Jan. 3. A fresh solution. Ditto, ditto.

Results:—An instant coagulum. Dense and flocculent; not a single rod.

Solutions in Strong Hydrochloric Acid, precipitated by Liquor Potassæ.

Expt. 84.

Dec. 30. Blood fibrin. Ditto, ditto.

Results:—Rods forming at once. No coagulum. Many rods. Apparent flocculi, when brought into focus, possess form. Many short rods. See Fibrin *ab* albumen, which this exactly resembles.

Expt. 85.

Fibrin *ab* albumen Ditto, ditto. In 3 minutes.

Results:—No coagulum. Rods forming, placed between two watch-glasses, exhibit nothing but what is formative, chiefly rods, some in bundles; not the slightest coagulum.

Expt. 86.

Dec. 30. Ov-albumen. Fresh. Ditto, ditto.

Results:—Instant coagulum. Not a single rod. Coagulum dense brown and yellow, or stone-coloured. On January 2nd two slight rods have formed.

NB.—All these experiments were again and again repeated, with similar results.

PROCEEDINGS OF SOCIETIES.

GEOLOGICAL SOCIETY OF LONDON.

December 20th, 1871.

Joseph Prestwich, Esq., F.R.S., President, in the Chair.

The communications read included the following:—

A letter from G. Milner Stephen, Esq., F.G.S., to the late Sir Roderick Murchison, dated Sydney, October 5, 1871, announcing the discovery of a rich auriferous deposit *on the banks* of the river Bondé, on the N.E. coast of New Caledonia, and of a great deposit of tin ore in the district of New England, New South Wales. The gold in New Caledonia is found in drift, and there are indications of the near proximity of a quartz reef. The tin ore in New South Wales is said to be in "pepitas, crystals, and beds of conglomerate, especially in micaceous granite, more or less decomposed."

Mr. D. Forbes stated that in 1859 he had placed in his hands some specimens of granite from the district the discovery of tin in which was announced by Mr. Stephen, and that he found them to be perfectly identical with the stanniferous granites of Cornwall, Spain, Portugal, Bolivia, Peru, and Malacca, which he had also examined. These granites were all composed of white orthoclase felspar, colourless or black Muscovite mica, and quartz. He was not aware that tinstone (cassiterite or oxide

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of tin) occurred anywhere in rock of a different character. It was always accompanied by more or less of the native gold.

Mr. PATTISON remarked that in many places where tin occurred it was not present in sufficient quantity to be remuneratively worked.

Mr. D. FORBES, in answer to a question from Professor Ramsay, stated that, as far as could be ascertained, the age of the stanniferous granites mentioned by him must be between the end of the silurian and the early part of the carboniferous period.

Prof. RAMSAY would carry them down to the close of the carboniferous period, and would be contented to term them pre-permian.

"*Remarks on the Greenland Meteorites.*" By Prof. A. E. Nordenskjöld, For. Corr. G.S.

The author stated that the masses of meteoric iron brought from Greenland by the recent Swedish expedition seem to have formed the principal masses of an enormous meteoric fall of miocene date, extending over an area of some 200 miles. The iron appears to be free from silicates. Against its eruptive origin the author urges that when heated it evolves a great amount of gaseous matter, and that it contains imbedded particles of sulphide of iron, the mass itself being nearly free from sulphur. The masses are composed of meteoric nickeliferous cast- and wrought-iron, or of mixtures of the two; in the last case the Widmannstætten's figures are best developed. The author further noticed the various modes in which the iron occurs, viz.:—

(1). As meteorites.

(2). Filling cracks.

(3). As brecciiform stones cemented with oxide and silicate of iron.

(4). In grains disseminated in the basalt.

Mr. ROBERTS protested against the evolution of gaseous matter being considered as a proof of meteoric origin.

Professor RAMSAY reiterated his previously expressed opinion that "the masses of iron might be of telluric origin."

MISCELLANEOUS.

University College.—At a session of Council on the 6th inst., Mr. J. Booth, C.B., in the chair, after the reading of the School Committee's Report, in which the Committee represented the urgent necessity of an extension of the school buildings in order to accommodate the rapidly increasing number of pupils, Mr. Samuel Sharpe, a member of the Council and of the Committee, announced his intention to present the College with the sum of £4000 as a contribution to the cost of the required buildings. The cordial thanks of the Council were at once voted to Mr. Sharpe for this most generous gift, the gratitude evoked by which was enhanced by the recollection of former liberal donations to the College from the same gentleman, who had previously given two sums of £1000 each to the School-Building Fund, £1000 to the Retired Professors' Fund, £600 to the Fine-Art Building Fund, and several other lesser sums for various college purposes. The College has recently received from another liberal friend, Mr. J. Pemberton Heywood, a donation of £1000 to the School-Building Fund, to which he had contributed a like sum a few years ago, besides £500 to the Fine-Art Building Fund. At the same session a communication was read from the late Mr. Felix Slade's executors, in which they stated that, having been informed that further assistance was needed to defray the cost of the Fine-Art Buildings at the college, and to provide casts and other appliances for the use of the students, they had determined to place in the hands of the Council the sum of £1600, to be applied for the purposes above mentioned. It may perhaps be remembered that about two years ago the executors gave to the College £5000 towards the Building Fund, in addition to the large endowments for the Slade Professorship and Scholarships founded at the College, in pursuance of the directions contained in Mr. Slade's will. The best thanks of the council were voted to Mr. Slade's executors for this further proof of the desire which they have on every occasion evinced to promote the interests of the Fine-Art Department of the College. A resolution was adopted at the same session to admit ladies attending the class of political economy to compete for the prizes and the Hume and Ricardo Scholarships, awarded for proficiency in that Science.

Oxidation of Carbon and Artificial Production of Aniline.—At the meeting of the chemical section of the German Association for the Advancement of Science, at Rostock, on the 18th of September, 1871, the President, Professor Schulze, read a paper, on the direct oxidation of carbon by means of permanganate of potash in an alkaline solution, which excited lively debate, and was justly regarded as one of the most important chemical discoveries of the year. In addition to copious quantities of oxalic acid and of other products not yet determined, the author obtained an acid to which he has given the name of anthraconic, and which he found to closely resemble mellitic acid in its properties. The experiment was repeated with charcoal purified in a stream of chlorine gas, also by calcining cream of tartar, by the reduction of carbonic acid with phosphorus, and from graphite. All of these varieties of carbon yielded analogous results. So great was the interest manifested in the announcement, that the leading chemists adjourned to the Professor's laboratory, there to repeat the tests and to examine into the nature of the incidental products. They soon came to the conclusion that the new body was identical with mellitic acid. By treating the anthraconic acid with caustic soda, benzole was produced, which was converted into nitrobenzole in the usual manner, and from this product aniline was manufactured. We have in this way the artificial production of aniline from charcoal, and are brought nearer to an explanation of the chemical properties of carbon and of important practical applications likely to grow out of such knowledge. It is another step in the distinguishing characteristic of modern research, namely, the synthetical method, or the building up of compounds from their constituent elements. It is easy to rend asunder and destroy, but to rebuild requires the application of the highest genius. The discovery of Professor Schulze is likely to prove of great importance, as soon as it is thoroughly understood and applied.—*Scientific American.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Annalen der Chemie und Pharmacie, November, 1871.

This number contains the following original papers and memoirs:—

Anthracen Derivatives.—C. Graebe and C. Liebermann.—This very lengthy essay, containing the detailed account of the latest researches on this subject, is divided into the following sections:—Anthracen-carbonic acid, $C_{14}H_9.CO_2H$; salts of this acid; behaviour of anthrachinon with various reagents; action of chloride of phosphorus upon anthrachinon; conversion of anthrachinon into anthrahydrochinon; behaviour of anthrachinon with caustic potassa; anthrachinon-sulpho acids; anthrachinon-mono-sulpho acid—

$$C_{14}H_7(O_2)SO_2H;$$

salts of this acid; behaviour of this acid with hydrate of potassa anthrachinon-bisulpho acid, $C_{14}H_6(O_2)(SO_2H)_2$; salts of this acid;

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its behaviour with caustic potassa; formation of anthrachinon-bisulpho acid from bibrom- and bichlor-anthracen; oxyanthrachinon-sulpho acid, $C_{14}H_6(O_2)''(OH)(SO_2H)$; oxyanthrachinon, $C_{14}H_7(O_2)''OH$; behaviour of alizarin-sulpho acid with caustic potassa.

On some of the Nitrogen Compounds of Anthrachinon.—R. Böttger and T. Petersen.—Notwithstanding the scientific value of this essay, its very great length renders it impossible to quote any details excepting the headings of the sections into which it is divided:—α dinitro-anthrachinon, $C_{14}H_6(NO_2)_2O_2$; α diamido-anthrachinon, $C_{14}H_6(NH_2)_2O_2$; behaviour of this body with nitrous acid; behaviour of α dinitro-anthrachinon with concentrated sulphuric acid; researches on the absorption-spectrum of alizarine.

On Toluylen Alcohol, Isotoluylen Alcohol, and Stilben Alcohol.—H. Limpricht and H. Schwanert.—Toluylen alcohol is a solid crystalline substance, having no constant melting-point, difficultly soluble in hot water, and readily so in ether and boiling alcohol. Toluylen alcohol yields, with glacial acetic acid, an ether—

$$C_{14}H_{12}(C_2H_3O)_2O_2,$$

a solid crystalline body, insoluble in water, but readily soluble in alcohol. Isotoluylen alcohol is also a solid body, fusing at 96°, soluble in alcohol; simplest formula, $C_{14}H_{12}O_4$. Stilben alcohol, $C_{14}H_{14}O_2$, is obtained by heating benzoin along with an alcoholic solution of caustic potassa; the substance alluded to crystallises in large-sized prismatic crystals, is readily soluble in ether and hot alcohol, and fuses at 132°. The authors describe in this lengthy essay a series of combinations of these substances with other compounds, and the reactions which take place when these bodies are treated with various chemicals.

Essential Improvement of the Method of Fractional Distillation.—E. Linnemann.—This essay is illustrated by engravings representing an ingeniously contrived apparatus for fractional distillation, and recording a series of very accurately made experiments with the same.

The Chlorhydrates of Hydroxylamine.—W. Lossen.—Semi-chlorhydrate of hydroxylamine may be obtained in crystalline state, but, being very deliquescent, it is only so obtained from a very concentrated aqueous solution; this substance fuses at 85°, and consists of $2NH_4O,HCl$. The sesquichlorhydrate, $3NH_3O,2HCl$, is also a deliquescent body, fusing at 95°, somewhat soluble in alcohol, but not at all in ether.

Preparation of Absolute Alcohol.—E. Erlenmeyer.—After briefly referring to the difficulty and loss of time experienced in the preparation of absolute alcohol by the aid of such substances as carbonate of potassa, anhydrous sulphate of copper, dried ferrocyanide of potassium, caustic potassa, caustic baryta, &c., the author states that, after all, caustic lime is the best, and, indeed, as proved by Dr. Mendelejeff (*Zeitschrift für Chemie*, 1865, p. 260), the only, substance which will answer the purpose of rendering alcohol anhydrous. The author has somewhat modified Mendelejeff's method by causing the alcohol (of course very strong, and containing already less than 5 per cent of water) intended to be made absolute to boil along with the caustic lime for about one hour, the apparatus being so arranged that any condensed alcohol flows back into the retort. After the lapse of the time alluded to, the distillation is proceeded with, the result being that the distillate (several litres by bulk) is all obtained in anhydrous state. With an alcohol containing more than 5 per cent of water this same operation has to be repeated several times.

The Question whether the Allyl Alcohol Contains or does not Contain the Methyl Group.—E. Linnemann.

Journal für Gasbeleuchtung und Wasserversorgung, No. 22, 1871.

The original papers contained in this number relate strictly to subjects on gas- and water-works' engineering and management.

Journal de Pharmacie et de Chimie, November, 1871.

This number contains the following original papers and memoirs relating to chemistry:—

Mode of Distribution of Potassa and Soda in Plants.—E. Peligot.—This essay is mainly the same as that published in the *Comptes Rendus* of November 6 last (see CHEMICAL NEWS, vol xxiv., p. 252).

Some Particulars on the Analysis of so-called Roman Camomile Flowers (Anthemis Nobilis).—Dr. Camboulises.—After first referring to the researches of M. Pattone on the common camomile (*Anthemis arvensis*), published some years ago, the author states that the flowers he experimented with contain, in addition to an essential oil, fat, a bitter principle, glucose, and a very small quantity of a peculiar acid, which seems to be identical with anthemic acid. The ash of the flowers contains sulphate and carbonate of potassa, chloride of potassium, a soluble alkaline phosphate, silica, carbonate of lime, and phosphate of lime and magnesia.

Alkaloids of the Cinchona Trees.—Dr. J. E. Vrij.—The quantitative estimation of the cinchona alkaloids as carried on by the author is based upon:—(1) The very slight solubility of the bitartrate of quinine in water, and the large solubility of the bitartrates of the other alkaloids; (2) the slight solubility of the neutral tartrate of cinchonidine in water, and the somewhat greater solubility of the neutral tartrates of the other alkaloids; (3) the great tendency of iodosulphate of quinine to be formed by the addition of an alcoholic iodine solution to a solution of quinine in alcohol at 50 per cent, containing 1-20th of sulphuric acid, and the slight solubility of this compound in alcohol at 95 per cent; (4) the great solubility of the iodosulphate of the amorphous alkaloid in alcohol at 95 per cent; (5) the existence of at least three alkaloids in all the barks tested by him: (6) all the Indian cinchona barks—of the British as well as of the Netherlands colonies, contain an amorphous alkaloid which is soluble in ether.

Gazzetta Chimica Italiana, December, 1871.

This number contains the following original papers and memoirs:—

Synthesis of a New Phenol.—Dr. E. Paterno.—After first referring to some researches of Drs. A. Jena and T. Zincke, collaterally bearing upon this subject, and published some years ago, the author states that he obtained, by mixing, equivalent quantities of chloride of benzyl and anisol, and, heating this mixture along with zinc-filings, a strong reaction ensues, hydrochloric acid being evolved; the liquid, having been decanted from the zinc, and, submitted to distillation, yields an oily fluid heavier than water, very transparent, which, on being analysed, gave results leading to the formula $C_{14}H_{14}O$; constitutional formula—

$$\begin{matrix} C_6H_5 \\ | \\ CH_2 \\ C_6H_4.O.CH_3 \end{matrix}$$

This formula is confirmed by the fact that when the compound alluded to is heated up to 150° along with hydriodic acid in a sealed tube, iodide of methyl is formed.

Action of Bromochloride of Phosphorus on Chloral.—Dr. E. Paterno.—After first referring to his researches on the action of perchloride of phosphorus on chloral (*Giornale di Scienze Naturali ed Economiche*, vol. v., p. 117), the author describes at great length his experiments on the subject alluded to, the chloral being the anhydride. The result of the reaction is the formation of a compound, $C_2HCl_3Br_2$, a perfectly colourless transparent liquid, which strongly refracts light, is gradually decomposed by direct sunlight, and becoming yellow-coloured; its smell is agreeable and slightly camphor-like; it is insoluble in water; boils, but is partly decomposed, at 200°; is not congealed by exposure to the cold produced by a mixture of snow and salt; sp. gr. at 0° = 2·317.

On Two New Chlorobromides of Carbon.—Dr. A. Paterno.—This lengthy essay is divided into the following sections:—Action of bromine upon chloroform; hereby is formed a substance, CCl_3Br, a transparent very mobile liquid, perfectly colourless when first prepared, but becoming decomposed even by exposure to diffuse light, bromine being set free; the odour emitted by this substance is agreeable, and somewhat akin to that of a mixture of chloroform and chloride of carbon; this chlorobromide of carbon boils at 104·3°, and has a sp. gr. at 0° = 2·058. Action of bromine on pentachloride of dimethyl; hereby another chlorobromide of carbon is formed, $C_2Cl_4Br_2$, a crystalline solid.

Bromide of Ethyliden.—Drs. E. Paterno and G. Pisati.—By causing bromochloride of phosphorus, $PhCl_3Br_2$, to act upon pure aldehyde, the authors have obtained a product, which, having been rectified, was found to boil at about 112°, and to be composed of $C_2H_4Br_2$, and is therefore a bromide of ethyliden.

Annalen der Physik und Chemie, von Dr. J. C. Poggendorff, No. 10, 1871.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

On Electrolysis, and on the Conduction of Electricity through Fluids.—G. Quincke.—The continuation and end of this very lengthy memoir.

Composition of the Native Tantalum and Niobium Compounds, and more especially of Tantalite, Columbite, and Pyrochlor.—C. Rammelsberg.—The continuation and end of this very exhaustive mineralogical essay.

Action of Light upon Chlorine and Bromine.—E. Budde.—The leading points of this paper may be summarised as follows:—Light (sunlight) decomposes the molecules of chlorine; light acts also in another manner (the nature of which is not precisely known) in which, becoming converted into heat, it causes expansion; the division of the solar spectrum, according to Melloni, into a heating and non-heating chemically acting portion, is not quite correct, since there exist substances which are more heated by the violet than by the red rays.

Mineralogical Communication.—G. vom Rath.—Tenth portion of this essay, treating on the chemical composition of the lime-soda felspars, a contribution to the doctrine of isomorphism. To be continued.

Evolution of Heat which Accompanies the Drawing-Out of Caoutchouc.—E. Villari.—A mechanico-physical essay.

Influence of the Astronomical Motions on Optical Phenomena.—E. Ketteler.

Sound Emitted by the Cuckoo Considered in its Acoustical Relation.—J. G. Oppel.

Preparation of Collodium Paper.—E. Zettnow.—The detailed account of a series of experiments made by the author on this subject.

Microscopical Composition of Clay-Slates and Roofing-Slates.—F. Zirkel.

Chromatic Polarisation of Hailstones.—J. Müller.—From the author's researches it appears that hailstones are not made up of amorphous but of crystalline ice, which is put together in all directions.

Use of Cylindrical Lenses for Spectrum Observations.—L. Schönn,

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Caloric Condition of Sound-Giving Columns of Air.—Dr. H. Schneebeli.

Les Mondes, December 28, 1871.

Fourth Centenary of Copernicus.—Great preparations are being made at Posen (Prussian-Poland) for celebrating on February 19 next the fourth centenary of the celebrated astronomer, who, though born at Thorn, was in reality a Polander, and inscribed as such at the University of Padua (Italy), where he studied.

Reform of the Legislation of the Brevets d'Invention.—Count de Douhet.—The author, a member of the National Assembly of France, gives an excellent review on this subject, pointing out what has to be amended and improved.

Luminous Meteors and Auroræ Boreales Observed in Italy during the Month of November.—Rev. Father Denza, S.J.

Diving-Bell.—G. B. Toselli.—Illustrated with woodcuts. Description of a novel apparatus which has been successfully tried in the Mediterranean.

There is added to this number a separate half-sheet, which bears the title of—

Panorama du Tout Savoir, Arbre des Connaissances Utiles Réduit à ses Branches Mères, par E. Lagout.—The contents of this paper deserve attention on account of the excellent and concise, yet clear, method of exposition.

January 4, 1872.

Important Invention.—E. Dubois.—The author states that he has been for some time engaged with experiments on devising means for so arranging ships' compasses as to obviate the effects of the deviation of the magnetic needle, and thereby preventing fatal accidents to vessels at sea in consequence. The result is an instrument termed a gyroscope-compass, which has been tried and found to answer admirably on board of two French men-of-war.

Oxyhydrogen Light in the Streets of Paris.—Rev. F. Moigno.—From a short notice on this subject, we learn that the light alluded to (similar to that exhibited at the Crystal Palace) has been now introduced in some parts of the Boulevards of Paris; the success is complete in every respect, and does great credit to the inventor, Tessié du Motay.

Observations on Dr. J. von Liebig's Essay on Fermentation.—Dr. Pasteur.—Notwithstanding the intrinsic merits of this memoir, its contents are not suited for useful abstraction.

Autographic Electro-Telegraphic Apparatus.—M. Meyer.—Illustrated by woodcuts.

Electro-Telegraphic Relais Based upon a New Electro-Magnetic Principle.—M. D'Arlincourt.—The description, illustrated by engravings, of an instrument whereby telegraphic messages can be transmitted, without the necessity of being first forwarded to any intermediate station, at once to the place of destination, however distant that may be from the starting-point.

Study on the Molecular Vibrations of Mercury and of Liquids in General.—M. Barthelemy.—The description, illustrated by woodcuts, of a series of acoustic experiments.

Polytechnisches Journal von Dingler, second number for November, 1871.

This number contains the following original memoirs and papers relating to chemistry and collateral sciences:—

Present Condition of Aërial Navigation.—T. Springmann.—This elaborate memoir, illustrated by several engravings, contains a very complete and well-digested account of all that has been done in this direction in various countries.

Hydraulic Properties of Gypsum which has been Ignited to Red Heat.—F. Schott.—From the contents of this lengthy essay we quote the following essential points:—What is usually termed overburnt gypsum reassumes, after a lapse of some days, its property of absorbing water, and hardening after that. When gypsum is heated to a temperature higher than that at which it parts with its water of hydration, it hardens, and somewhat fuses, becoming more dense, and taking up water less readily; this gypsum takes up less water, and thereby becomes a harder mass than is usual with so-called plaster-of-Paris. The following modifications of sulphate of lime exist:—(*a*) Crystallised hydrated (as met with native), with 20·93 per cent of water of hydration. (*b*) Three-fourths dehydrated (as is the usual so-called plaster-of-Paris), containing 4·27 per cent of water of hydration, readily hardening after having been mixed with water. (*c*) Completely dehydrated gypsum, but not heated above 200°, readily hardens when mixed with water. (*d*) Anhydrite (native), takes up water slowly, and only after a length of time, but does not become hydraulic. (*e*) Gypsum heated to red-heat, or to from 400° to 500°, also anhydrite, but becoming hydraulic, that is to say, yielding with water a kind of hydraulic lime.

Softening of Water by Means of Lime.—J. Stingl.—The author records the results of a series of experiments made with water in use at one of the railway stations at Vienna, where, for the purpose of softening the water to be applied for feeding locomotive-engine boilers, the lime process is in use, to which is added a peculiar mode of filtering, so that the tedious process of obtaining the water clear by letting a sediment form is got rid of. There are added to this paper results of analysis of the water before and after softening, of the boiler incrustation due to the softened and unsoftened water, and of the residue left on the filters. If water contains in addition to carbonate of lime much gypsum, it is first treated with lime, and next with carbonate of soda.

Simplified Method of Estimating Carbonic Acid in the Gas used for Saturation (viz., of Lime) in the Sugar Refining Industry.—Dr. T. Stammer.—Illustrated with a woodcut essentially required for the proper understanding of the subject.

On Leucoline Oil, and on the Pure Naphthalin of Commerce.—Dr. M. Ballo.—By treating a quantity of some 30 kilos. of crude naphthalin with dilute sulphuric acid by the assistance of heat the author obtained an oily deliquescent mass, which, having been rectified in various ways, was found to be a mixture of various basic bodies wherein leucolin prevails. This oil yields with iodide of amyl and caustic potassa solution a beautiful violet dye, which is identical with that obtained from cinchonin-chinolin; the so-called naphthalin of commerce owes its peculiar odour to leucoline oil, which can be eliminated by treating the naphthalin with bichromate of potassa and dilute sulphuric acid.

Testing Citric Acid for Tartaric Acid.—Dr. Hager.—First a mixture is made consisting of 4 grms. of fused caustic potassa, 60 c.c. water, 30 c.c. alcohol at 90 per cent; this liquid is poured into a glass basin placed on a piece of black paper so as to form a layer of some 6 m.m. high; next crystals of the citric acid to be tested are placed into this fluid so that the crystals do not touch each other and are some 3 to 5 centimetres apart. After having been left quietly standing for about three hours the crystals of citric acid will be found either entirely, or, at least, nearly, dissolved, there being left only a whitish speck where they had lain, but the crystals of tartaric acid if anywhere present will have been left undissolved and covered as well as surrounded with a whitish crystalline mass.

Composition of the Swedish Safety Matches.—A. Kriwanek.—The mass fixed to the wooden splints consists, in 100 parts of—Glass-powder, 8·77; glue, 7·12; neutral chromate of potassa, 7·36; chlorate of potassa, 46·76; hydrated oxide of iron, 5·39; peroxide of manganese, 13·07; sulphur, 7·41; hygroscopic water, 4·22. Friction mass on the boxes—Glue, 3·65; hydrated oxide of iron, 3·19; peroxide of manganese, 13·06; tersulphide of antimony, 50·34; amorphous phosphorus, 29·91.

NOTES AND QUERIES.

Sprengel Mercurial Pump.—Will any of your readers inform me where I can read a good description of the Sprengel mercurial pump and its application to filtering? Also please give some idea of the quantity of mercury required for its proper working.—M.

Refining of Paraffin.—(Reply to "M. P. S.").—You will find the most recent and best information in "Die Industrie der Mineralöle, des Petroleums, Paraffins, und der Harze," &c., von H. Perutz Wein, bei C. Gerold, 1868; you can inspect this book at the Library of the Commissioners of Patents.

Residue from Olive Oil Presses.—(Reply to "Oleum").—It is not likely that you can obtain this material now, the gathering of the olives for preparing oil having taken place some time since; the only way to obtain the olive cake when in season is to apply to some of the wholesale traders in this oil at the ports of shipment, either in France, Italy, or Spain.

MEETINGS FOR THE WEEK.

MONDAY, Jan. 15th.—Medical, 8.
—— London Institution, 4. Prof. Odling, F.R.S., on "Elementary Chemistry."
TUESDAY, 16th.—Royal Institution, 3. Dr. W. Rutherford, F.R.S.E., "On the Circulatory and Nervous Systems."
—— Civil Engineers, 8.
—— Zoological, 9.
WEDNESDAY, 17th.—Meteorological, 7.
—— Society of Arts, 8.
THURSDAY, 18th.—Royal, 8.30.
—— Chemical, 8.
—— Royal Society Club, 6.
—— Royal Institution, 3. Prof. Odling, F.R.S., "On the Chemistry of Alkalies and Alkali Manufacture."
FRIDAY, 19th.—Royal Institution, 9. Prof. Odling, F.R.S., "On the New Metal Indium."
SATURDAY, 20th.—Royal Institution, 3. Wm. B. Donne, "On the Theatre in Shakespeare's Time."

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January, 1872.

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THE CHEMICAL NEWS.

VOL. XXV. No. 634.

ON THE

ESTIMATION OF NITROUS ACID IN NITRO-SULPHURIC ACID.

By GEORGE E. DAVIS.

IN vol. xxiv., p. 257 of this journal, I compared the chloride of lime process for the estimation of nitrous acid in nitrous vitriol with a permanganate process, and I there showed that with me there sometimes arose discrepancies between the two methods which are difficult to explain. That it is the permanganate process which is at fault may be seen at a glance, although the chloride of lime method is not free from error. This may be seen by inspecting column 2, p. 258, where five different trials of the same sample by the chloride of lime process only showed a difference of two degrees, whilst five more trials by the permanganate process varied between 55 and 60 c.c., making a difference percentically :—

	Chloride of Lime.	Permanganate.
Highest result.. ..	1·212	1·140
Lowest ,, ...	1·184	1·045
Difference	0·028	0·095

The difference between these two processes it will be seen is only very minute, and, indeed, such as is usually allowed as errors of experiment; but such errors, even so small, are scarcely allowable in this case, for the error would be greater than the amount of nitrous acid sometimes found. For instance, on page 249 Mr. W. Crowder states that in the third works where the acid is denitrated by steam and sulphurous acid, that there remains after leaving the column 0·026 per cent of nitrous acid.

By allowing, as I stated before, the solution, by the permanganate process to stand two minutes, results are obtained which are generally 0·1 per cent under the other method; this I first attributed to faulty solutions, but on testing the chloride of lime solution by Bunsen's method, and the permanganate by pure oxalic acid, I found them accurate.

I have, therefore, in my daily determinations always preferred the chloride of lime, for the estimations agree when many are made upon the same sample, and it has the advantage of being the most rapid of all the methods which I have yet tried, and also the least expensive, urea being too dear when four determinations are made in a day.

In order to eliminate this constant difference of 0·1 per cent the operation was reversed, the nitrous vitriol was added to the $\frac{N}{10}$ permanganate, and at first the error was increased instead of being eliminated, which led to the discovery of the fact that the more time employed in the operation the higher the result. As an instance, 50 c.c. of the decinormal permanganate were placed in a flask with a litre of water, the flask was shaken in one hand whilst the nitrous vitriol was delivered by the other, which was added until decolouration took place; 8·2 c.c. were used, which indicated 1·158 per cent. A litre of water was again placed in a flask with 50 c.c. of the permanganate; 5 c.c. of the vitriol were added at once and well shaken, then a few drops at a time, well shaking after each addition: this time, although the same sample of vitriol was operated upon, 6·7 c.c. were only required, which is equal to 1·418 per cent. The sample was then tested by the chloride of lime method; 64 divisions were taken, which indicates 1·609 per cent of nitrous acid; the first experiment occupying two minutes, and the last ten.

This lengthening of the process, which I have found to be necessary, corresponds to that in the first permanganate process described, where the pinkish liquid is directed to stand for two minutes; the oxidation at the end of the process taking place very slowly indeed. By taking every precaution to ensure accurate results, numbers have been obtained which agree very closely with the former permanganate process and also with the chloride of lime method.

The table below gives the results of the estimation of the nitrous acid in five different samples of nitrous vitriol by the three processes: 1st, the chloride of lime; 2nd, the process by which the N_2O_3 in 10 c.c. of the vitriol is estimated by $\frac{N}{10}$ permanganate; this I will call the α permanganate process; 3rdly, the β permanganate process, in which the nitrous vitriol is added to 50 c.c. $\frac{N}{10}$ permanganate until decolouration takes place :—

Chloride of Lime.		α Permanganate.		β Permanganate.	
No. of Pouret Div.	Per cent N_2O_3.	C.c. used.	Per cent N_2O_3.	C.c. used.	Per cent N_2O_3.
87	1·184	60	1·140	8·2	1·158
92	1·119	56	1·064	8·5	1·117
64	1·609	79	1·501	6·7	1·418
46	2·239	112	2·128	4·4	2·159
154	0·669	30	0·570	14·1	0·673

To guard against loss of chlorine as much as possible by the chloride of lime method, I now employ a stoppered bottle of 1750 c.c. capacity: a litre of water is placed in, and then the 10 c.c of the chloride solution containing the 7 grs. of chlorine, the nitrous acid is then poured in, the stopper instantly replaced, and the bottle well agitated; this is repeated until there is no smell of chlorine; a few drops of indigo sulphate are then added, and if the solution keeps its blue colour the operation is ended. Both nitrous acid and chlorine decolourise indigo, therefore if the bottle with its contents are allowed to stand some time before being washed out, the operator will have a good indication whether an excess of nitrous vitriol has been added or not.

Although the chloride of lime method has been spoken of as the best to use for technical purposes, and one which may be so readily applied, yet there are cases in which its use is not to be recommended. There are, when the acid contains only traces of nitrous acid. I say traces, but to be more exact I will say, when there exists only from 0·2 to 0·02 of N_2O_3 in the 100 of acid; 0·171 of nitrous acid per cent would require 600 divisions to be added, therefore requiring six fillings and emptyings of the pouret.

The process to use in this and similar cases is the permanganate process, which in the instance of traces of N_2O_3 is very readily and quickly performed. It has been hinted to me by several chemists since the appearance of my paper on the subject that the lower results of the α permanganate process were caused by the liberation and escape of nitrous acid by dilution with water. I wish now to state that such is not the case, there is no liberation of nitrous acid into the atmosphere of the flask and consequently no escape. The nitrous vitriol is taken up with a 10 c.c. pipette, and the point is inserted to the bottom of the water in the flask; the vitriol is now allowed to run out and form a layer at the bottom of the water; now by giving a slight circular motion the water and vitriol may be made to mix without any loss. As I have before stated in my experiments, iodide of potassium and starch-paper were not affected at all by the air of the flask immediately over the solution.

For some time I found it very difficult to explain why the colour of the permanganate which seemed permanent should go after standing a few seconds, but I think now that this peculiarity may be traced to the behaviour of N_2O_3 with water.

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Nitrogen trioxide or nitrous acid is generally admitted to be decomposed by water after the manner of the following equation: $3N_2O_3+H_2O=2HNO_3+2N_2O_2$. Three molecules of nitrous acid require 6 atoms of oxygen to oxidise it to nitric acid; that is one side of the equation. Two molecules of nitric oxide require 6 atoms of oxygen also; this is the other side.

Thus there is no difference in the *amount* of oxygen required for the oxidisation of the nitrous acid contained in vitriol, either before or after dilution with water; but it is very probable that the N_2O_2 cannot assimilate the oxygen of the permanganate so easily as the N_2O_3; consequently the decolouration is retarded.

Mr. W. Crowder has given the results of denitration under varying conditions. I here append a table containing some of the results obtained in denitrating with chamber acid and the hot sulphurous gas; the first relates to the absorbing column, and the acid going to it was tested by the *a* permanganate process. The acid coming from it was tested by the chloride of lime method:—

	To Absorbing Column.		From Absorbing Column.	
No.	Density.	P.c. of N_2O_3.	Density.	P.c. of N_2O_3.
1	152	0·130	148	1·338
2	152	0·197	148	1·426
3	156	0·166	149	1·717
4	151	0·092	145	2·102
5	155	0·123	148	2·803
6	154	0·088	150	1·936
7	158	0·162	152	2·557
8	156	0·076	152	1·342
	To Denitrator.		From Denitrator.	
No.	Density.	P.c. N_2O_3.	Density.	P.c. N_2O_3.
10	149	1·839	152	0·184
11	153	2·056	153	0·126
12	151	1·788	149	0·097
13	150	2·264	138	0·104
14	150	1·212	133	0·067
15	152	1·875	140	0·086
16	118	0·1266	—	—
17	124	0·1393	—	—
18	121	0·1692	—	—

In the above tables Nos. 1, 2, 3, and 4, were run down from the denitrator at that strength; Nos. 5, 6, 7, and 8, were run down at 138, and boiled down to the strength indicated by the tables.

Nos. 10, 11, and 12 are specimens of denitrations when the acid leaving the denitrator is strong enough to be employed in the absorbing column.

Nos. 13, 14, and 15 are specimens when the acid was leaving the denitrator at a density varying from 133° to 140° T., and 16, 17, and 18 represent the chamber liquor which was being run down the denitrator with the nitro-sulphuric acid.

January 8, 1872.

NOTES OF DEMONSTRATIONS ON PHYSIOLOGICAL CHEMISTRY AT ST. GEORGE'S HOSPITAL.

By S. W. MOORE.

VIII.

From the frequent occurrence of the necessity of identifying blood stains in medico-legal cases it is desirable that a good test should be known; there is one which answers the purpose fairly, but unfortunately does not differentiate human from animal blood. This is the guaiacum test.

The constitutent, hæmatine, upon which the reaction is based, is identical in all blood, even that of the common earthworm; this identity is proved by the spectroscopic appearances.

To apply the above test, place a drop of blood on a white surface of porcelain, and add to it a drop of simple tincture of guaiacum; to this add a drop of solution of peroxide of hydrogen (H_2O_2); a blue colour will be developed. If the stain of blood be dry, moisten with glycerine, apply the tests and press it with a piece of white blotting-paper; this will absorb the colour.

The action depends on the oxidation of the guaiacum in the presence of the hæmatine.

The red corpuscles of the blood are composed principally of hæmatocrystalline — that is, hæmatine, the colouring matter, and crystalline or globulin, an albuminoid body identical with the substance obtained from the crystalline lens of the eye.

Hæmatocrystalline may be obtained from its aqueous solution in crystals by subjecting it to cold. To obtain hæmatocrystalline from corpuscles, separate them from defibrinated serum with salt water and then wash with ether and water; the water dissolves the hæmatocrystalline. These crystals have a very complicated formula, and a molecular weight of about 13280, the highest molecular weight at present known (Thudichum). These results were calculated from Schmidt and Seyler's analyses, the formula given being $C_{600}H_{960}N_{154}FeS_3O_{177}$.

Hæmatocrystalline is an exceedingly stable body, remaining undecomposed in putrid blood of long standing.

Hæmatine, the colouring matter of blood, contains Fe in large quantities, 7 per cent of the ash; it cannot be wholly separated, but the colour is not affected by the removal of that portion which can be removed.

I mentioned in last demonstration that corpuscles are essentially carriers of O; this is proved in a very pretty manner by reducing arterial blood with H_2S, or protoxide of iron in ammonia tartrate, and subjecting to spectrum analysis; the bands of venous blood immediately appear, by exposure O is absorbed from the air, and the arterial bands appear.

Hæmatine may be obtained from hæmatocrystalline or the crude corpuscles by washing with alcohol acidulated with H_2SO_4.

Hydrogen phosphide and hydrogen sulphide reduce hæmatine, and CO, NO_2, and HCN combine readily with it.

Cruentine, an interesting body obtained from blood in the form of sulphate, by treating with H_2SO_4, is remarkable for a property known as fluorescence, and peculiar to a few substances only.

Chloroform saturated with cruentine sulphate, and subjected to a cone of sunlight or the extreme violet acid of the spectrum, gives this fluorescence in a beautiful manner.

Besides the bodies already mentioned, there are a few others, as albumin in the serum, some phosphorised fat, urea, cholesterine, and other matters about to undergo excretion.

NOTE ON THE OXIDATING POWER OF SOLUTIONS OF PERMANGANATE OF POTASH.

By HUGO TAMM.

While Professor Schulze was engaged in his researches on the oxidising power of alkaline solutions of permanganate of potash, I was carrying out similar experiments on neutral soutions of this substance, and I was studying their action on the substances which reduce them.

I studied, at first very roughly, the action of the chameleon on various substances, such as filter-paper, tartaric acid, coal-gas, tallow, turpentine, benzol, alcohol, ammonia, &c. The two most interesting facts which I found then were that alcohol boiled with a neutral solution of permanganate of potash was partially transformed into acetate of potash, and that, in the same conditions, ammonia was converted into *nitrate of potash*.

It is not likely that I shall be able to publish shortly my researches on this subject, but it is a great satisfac-

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tion to me to corroborate the importance of Professor Schulze's discovery by the publication of a not less interesting fact, viz., the direct oxidisation of ammonia by purely chemical means, a reaction which, as far as I can recollect, had not been obtained before.

TESTING COCHINEAL.

By J. M. MERRICK, jun., S.B.

I GIVE in the following article the outlines of the method I am in the habit of using for testing samples of cochineal to ascertain their comparative colouring powers. I have not seen it described in print, and while it is a much closer and more accurate method than that which is based upon dyeing strips of mordanted woollen stuffs, it is preferable to the bleaching with chloride of lime method, as the oxidising substance used, viz., potassic permanganate, does not precipitate the colouring matter of the cochineal.

I grind to a fine powder the samples to be tested, weigh out 2 or 2½ grammes, and boil this amount in a capacious narrow-necked flask, with 750 c.c. of water, for one hour. The liquid is immediately filtered through, dry paper filters, and tested when cold. To test it 50 c.c. are measured in a flask of that capacity and poured into another flask of about 200 c.c., and the measuring vessel rinsed with a definite quantity of water, say 10 to 15 c.c.

A weak solution of permanganate is then run in from a burette with a glass cock, the flask being shaken well after the addition of every 10 c.c.

So much permanganate solution is added that the cochineal extract shall be changed from its original colour to a pink of the very faintest shade—almost yellow, in fact, but never reaching a full yellow. This pink shade should be persistent, that is, it should not turn yellow after standing fifteen minutes; and after a little practice it will be found very easy to obtain the tinge, which shows that the colouring matter is almost but not quite destroyed.

When a number of samples are to be compared I arrange an equal number of 200 c.c. flasks and test-tubes on the table, a tube standing in its rack in front of each flask. Then the *same* number of c.c. of the permanganate solution (which should be at least so weak that bulk for bulk of this and the cochineal solution will be required), is run into each flask, taking care to use too little to completely destroy the colouring matter in *all*. The flasks are well shaken and allowed to stand for ten minutes.

Part of the contents of each is then poured into the corresponding test-tube, and a glance at the tubes as they stand side by side will show which is the least affected by the bleaching liquid. This sample having been selected to serve as a standard, the contents of the test-tube are returned to this flask, and more permanganate solution is cautiously added, until a very faint pink tinge, which a fraction of a c.c. will turn to a full yellow, is obtained.

The number of c.c. used having been noted, a fresh trial is made, in which the c.c. required, minus one, are used, the flask agitated, and the last c.c. or part of it, as the whole may not be necessary, added. If the two results agree, the next sample is treated in the same way, and so on until all are tested.

I usually make a final trial by measuring the 50 c.c. of each solution into its flask, running in the permanganate in the ascertained amount into each as quickly as possible, letting the flasks stand ten minutes, and then making a comparison of all in the test-tubes.

If the shades are not exactly alike, a pretty good guess can generally be made of the fractions of c.c. required, which should be added, the contents of the tubes being joined to that in the flasks, and a second or third comparison thus made.

This is a rather long description of what in practice is a very simple and good process, the three principal points to be borne in mind being,—

1st. To use a weak solution of permanganate.

2nd. To have a very faint pink colour as a standard of comparison.

3rd. To let the liquids remain after agitation together 10 to 15 minutes before comparing them.

I may add, that it is very remarkable how little can be told of the value of a sample of cochineal by a mere physical examination, and that the frequent inconsistency between value and price is equally surprising. I have known samples to differ *thirty* per cent in colouring power, and only one or two cents per pound in price.—*American Chemist.*

ON THE MANUFACTURE AND REFINING OF SUGAR.

By C. HAUGHTON GILL.

THE subject of sugar divides itself naturally into two branches—the preparation of the raw material, and the refining or rendering it fit for use. Taking these two branches of industry together, I find that the result is, that, in 1866, the total consumption amounted to something like three millions of tons, reckoning only that which came through European hands in some way or other, and of this amount nearly one million tons were manufactured in Europe from beet-root. No doubt some of you have heard that sugar made from beet-root is not so sweet as that ordinarily used in this country, which is made from the sugar-cane. This is quite a mistake. Sugar procured from the cane and from beet-root is exactly the same; and I wish to impress this upon you particularly at the outset, inasmuch as, in describing the operation of refining, I shall make no distinction between them, except in immaterial details. Sugar from either source is known as "cane-sugar."

I must next assign limits as to what I have to tell you. You must understand that I have nothing new to say upon this subject, but simply to explain to you what is known to every chemist who has studied the subject of the production and refining of sugar. I shall confine myself simply to telling you what is done in certain cases, and why it is done.

But, in order to explain the reason why such operations in the manufacture and refining of sugar are carried out in the form in which they are, I must first bring to your knowledge certain facts in chemistry and physics, and as I cannot advantageously unite these explanations with the descriptions of the processes themselves, I propose to occupy this first lecture on bringing before you some of these physical and chemical facts which I shall have afterwards to apply; and though this may appear a somewhat round-about way of attaining my object, I think it will really conduce to brevity and clearness.

First of all, I must state that the sugar which we obtain from the sugar-cane or beet-root exists already formed in those plants. It is not created by the process of manufacture, but exists in the plant, dissolved in water, in the shape of juice. But together with the sugar we find dissolved a variety of other bodies. I have in this bottle some of the pure juice of the sugar-beet which has been pressed out, and from the colour, which is nearly black, you will readily perceive that it is not a solution of pure sugar. It contains, among other bodies, a substance which approaches very nearly to the white of an egg, or albumen, and also some bodies like gums, the presence of which I can show you by adding to the liquid a solution of tannin, the astringent principle of oak-bark. By adding this, you will see in a few moments that these albuminous matters settle down in flocks, having formed insoluble compounds with the tannin; or I can show their presence more

* The Cantor Lectures, delivered before the Society of Arts.

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readily by using another reagent called "basic acetate of lead," which precipitates most of these albuminous and gummy substances as insoluble lead compounds. This basic acetate of lead has now produced a thick greenish precipitate in the beet-juice, and on filtering the mass you see that a clear, colourless liquid comes through, which you must understand contains the sugar of the original juice. Cane-juice contains the same, or similar impurities as beet-juice, though in much smaller proportions. The object of the sugar-makers is to remove, at the first operation, as many of these impurities as possible, so as to make his juice approximate as nearly as may be to a solution of pure sugar; but preliminary to the treatment of the juice comes the question of winning it, or getting it out of the plant. The most obvious way of doing that is to crush or rasp up the plant, thereby destroying the little cells in which this solution of sugar and other bodies is contained, and this is the method which is most commonly employed. I will go more into detail with regard to the extraction of the juice when I come to speak of the manufacture of beet-root sugar, which is that branch of the subject upon which I shall more specially enlarge; but I may here mention that there is another way of obtaining the juice, which, at any rate in principle, is preferable, but to explain to you what this is, I must first give an illustration of an important physical fact.

I have in this glass a solution of a gummy body, called dextrin, which is perfectly soluble in water, and a solution of which will readily filter through porous paper. I will mix with this a solution of bichromate of potash, which is a coloured salt, and, having mixed the two together, I will now fill a small sac, which is part of the gut of the rabbit or some small animal, with some of this yellow solution. The sac is what is called watertight, and I will now suspend it in a vessel filled with pure water. In process of time we shall see the solution the of this orange-coloured crystalline salt, the bichromate of potash, find its way out through the walls of the little watertight sac, whilst the gummy body itself will not pass through the membrane. Whilst that is proceeding, I will start a similar experiment on a somewhat larger scale. Over the mouth of this glass vessel I have a piece of parchment paper, which is quite watertight in the ordinary sense, but still it will allow this curious passage of some soluble bodies to take place through it, although it prevents the passage of others. I will put some of this mixture of dextrin and bichromate of potash into the vessel, and then placing it in a dish of water, we have the two separated simply by that piece of parchment paper, and we shall see that the bichromate of potash will pass through, whilst the dextrin will not. To show you how we can demonstate the truth of this, I must now show you the reaction of the dextrin and of the bichromate of potash. First, I will put a little of the dextrin into water, and add to it a solution of iodine. You perceive that the liquid immediately turns a dark purple colour. By this means, therefore, I can detect the presence of dextrin if it passes through into the water. The bichromate of potash has a very remarkable power of colouring water, and accordingly, even a small quantity of it would be manifested by the liquid turning yellow; but as that is not very visible in this light, I will add to it a solution of acetate of lead, which will form in the liquor a precipitate, the chromate of lead rendering it opaque and yellow. This difference between the two bodies with regard to their passing through moist watertight membranes, is one which is observed between two great series. On the one side we have those bodies which, when dissolved in water, will pass through most membranes, animal or vegetable, when there is water on each side; and we have again other bodies which, like the dextrin, do not possess that power. Those which can pass through are, for the most part, capable of assuming a crystalline condition, and the whole class, therefore, has been designated crystalloid. The others more or less resemble glue in character, and are called colloids. The constituents of cane and beet-juice are partly colloid and partly crystalloid. The solution of them is contained in little cells, which you may compare to the cells of an orange, the walls of which are capable of acting in the same way as this piece of membrane or this parchment paper, causing the separation of the two constituents of the cells, when slices of the plant are immersed in water, the crystalloid constituent passing outwards by this proceess of diffusion, as it is called, and the colloids remaining behind. If, then, we cut up a sugar-cane or beet-root into slices of a convenient size, and immerse them in water, the sugar, which is a crystalloid, and the saline particles of the juice, pass out into the water beyond, while the gummy bodies, to a great extent, remain behind; whereas when we rasp up the plant and squeeze out the juice, we get in it the whole constituents, colloid and crystalloid together. Theoretically, therefore, the diffusion process is preferable to the other. It is attended with some practical difficulties, which, however, have been got over very successfully in India, with regard to cane-juice, and which I have seen worked successfully with regard to the beet-root, though people are not quite agreed about it.

I will now come to the subject of the solution of bodies. Everyone knows, more or less, what is meant by solution, but there are some limitations to the process which are not always understood. If we take a body which is soluble in water, you know it disappears like sugar or salt when stirred up with water. Here is some of the yellow salt which I used just now, and dissolving some in water, you see that the liquid is immediately coloured, and it will go on increasing in colour up to a certain point, but the water will not dissolve more than a certain amount at this temperature. In this bottle there is some of the same salt which had been shaken up in the bottle for some days; the liquid is saturated with salt at this temperature, but though saturated at this temperature, it would not be so at another. For instance, if I put some of this saturated solution of bichromate of potash into a test-tube, and add some more of the solid salt and warm it, we shall find that when the liquid is heated, the power of solution of the water increases, and the solid salt disappears. I may, possibly, have added too much, because hot water has limited powers of solution as well as cold, and if we continued adding the salt to the hot liquid from time to time, we should at length arrive at a point when no more could be taken up, and then the liquid would be saturated at a high temperature. But if, instead of heating this up to the boiling-point, I had stopped short of that, and only saturated it at a temperature half-way between the boiling-point and the ordinary temperature of the room, I should have dissolved more of the salt than at the lower temperature, but less than at the higher. You must understand, therefore, that it is not because a liquid is what is called warm that it will dissolve as much of a given body as it will when it is boiling hot. As a rule, that is not the case, especially in the case of sugar. The large quantity of salt which I added here is now entirely dissolved, but on cooling the liquid again you will see, of course, that that portion of the salt which has become dissolved in virtue of the heat will again be deposited, leaving above it a cold saturated solution. It is important to recollect that this is the case, because on this fact depends the final extraction of sugar from its solutions. When the particles of salt, separated in this way from the hot saturated solution have time to arrange themselves in any way which the forces acting upon them may direct, they generally do so in very definite forms, and produce what are called crystals. On the table are two or three examples of crystals which have been formed in this way, by the slow cooling or evaporation of a liquid containing them in solution; the crystals are regular and of large size. But when the crystallisation produced is rapid—when it deposits more quickly—then we find that the deposit takes the form of small irregular crystals or grains. There is another way

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of obtaining a saturated solution of a soluble body besides this one of dissolving it in a hot liquid, and then cooling it, which is this. If you take a weak solution of a body and take the water out of it, you will obviously arrive at some point at which the body itself will remain relatively in excess. For instance, if I take a solution of common salt, and put it into a basin, and boil away the water, you will find that the salt will gradually crystallise out. Thus we arrive at the same result. We will now examine the result of our experiment on diffusion. I do not know whether it is very visible in the room, but to me it is perfectly clear that the water in the little jar in which the sac was placed is coloured yellow, especially at the bottom; and on examining the dish of water in which the vessel with the parchment paper was placed, I think we shall find the same result. I will divide the water which was outside the dialyser, as it is called, into parts. To one I will add a solution of iodine, and although I have added a larger quantity than I did before, you see there is no perceptible increase of colour. If, however, I add some acetate of lead, which I will do to the other portion, the precipitation shows at once that a considerable portion of "bichromate" has passed outwards. This is merely to show you, by a rough method, what takes place when the juices of plants are subjected to diffusion. Now, taking the liquid within the dialyser, we find that the iodine solution at once acts as vigorously as before upon the dextrine.

I have treated this subject very shortly, but I hope you understand distinctly the point which I wish to impress upon you about the solubility of bodies in cold and hot liquids, but there is a limit to each case, and that between a cold liquid and the hottest which you can make, for every temperature there will also be a special limit to the power of solution. I am speaking in general language, because every chemist present knows that there are exceptions to this rule, and some few bodies are more soluble in cold liquids than in hot; but still the great majority of bodies behave in the same way as sugar, and sugar is far more soluble in hot water than in cold; and for every temperature between the boiling and freezing points of water there is a specified limit of solubility. I have shown you that when a hot saturated solution is cooled, it deposits the salt which was dissolved in it by virtue of the high temperature, but when hot saturated liquids are cooled slowly and carefully, they pass through the limit of saturation in a most curious manner. I have here a flask filled with a perfectly transparent and very strong solution of a salt called sulphate of soda. It is quite cold, having been heated at about 12 o'clock, and it has been standing for some hours in cold water. Still there are no crystals formed, although there is a great deal more salt dissolved in the water than could have been dissolved if I had merely shaken it up with the salt—that is, at present the liquid is what is called supersaturated, and this state of supersaturation will continue until the liquid becomes disturbed in a peculiar way. Some liquids require to be disturbed in one way, and some in another, before this state of supersaturation is destroyed. It may suffice in this case to simply admit the air by withdrawing the cork. As I do so, probably a small particle of dust falls in, and you see, extending from the upper part downwards, an extremely rapidly crystallisation. So it will continue until the whole mass appears solid, the flask being in reality filled with large numbers of very minute crystals. At the same time, the temperature is somewhat risen, but we need not go into that. But what I wish you to understand from this experiment is that a liquid of a given temperature may at a given moment hold in solution more of a solid than it ought to, and in that case we call it supersaturated. We know nothing, I believe, at present why it is so, at least in many cases; in this particular case I believe it has been fairly explained. I will illustrate the same point in another case, in order to show you that, in some cases, we must disturb the liquid in a particular way if we wish to obtain this sudden crystallisation. Here I have a solution of another salt, which has been dissolved for some days. It is one which will admit of considerable rough treatment in the way of shaking without crystallisation; but if I open the jar and drop in a very small crystal of the same salt which is here dissolved, in a few minutes the whole liquid will become solid from the formation of crystals of dissolved material. This shows you that it is more difficult to disturb the equillibrium of sime liquids than others, and that you must seek special means for disturbing them in the right manner. If you dissolve in a liquid, sugar or any other body which is somewhat impure, which contains an admixture of foreign bodies, and then obtain crystallisation either by cooling a strong hot solution, or by evaporating off some of the water, you will attain a very considerable purification of that substance. In the process of crystallisation, the particles of the body come together and form a solid, leaving in solution those bodies which are present in quantities too small to crystallise out of the quantity of water still present and those which cannot crystallise at all. The crystals, when freed from their mother-liquid, must necessarily be considerably purer than the original material. This is an important point, because the purification of the crude sugar of commerce and rendering it into that beautiful white state in which we see it depends in a great measure on the power of crystallisation to separate impurities.

Having thus treated, as far as I am able at the present time, the subject of crystallisation, both in the ordinary case and from supersaturated solutions, I must proceed to describe what we understand by the term boiling, and to show under what conditions liquids can be boiled, and how the temperature at which they boil will vary under certain circumstances. You have all seen water boiling, and you know that when water is contained in a vessel, and heat applied to the bottom, large bubbles, not of air but of steam, are formed there, and rise through the liquor, creating quite a commotion, which we term boiling. Let us go back from that for a moment to the evaporation of a drop of water. If you spill a drop of water, you know that in a short time it dries up and disappears—it passes away into the air. This, of course, arises from the particles of the water gradually rising from the surface of the liquid into the air, and in so rising they had to overcome the pressure of the air on the surface of the liquid. You know that air presses with a force of about 15 lbs. per square inch, and that force tends to keep the particles down—to press them back into the water again. If that is the case, we should naturally suppose that if we could remove the atmosphere, the particles would rise more freely, and that is so. If we put a drop of water under the vacuum of the air-pump, it dries up very quickly indeed, there being nothing to keep it back. But what do we do when we apply heat to a liquid in a vessel? You know that you can dry wet, moist writing, or any other liquid, before the fire more quickly than if you simply expose it to the air at ordinary temperatures. This must be because the heat causes the particles of water to rise more quickly and readily, that is, it gives them a greater force to overcome the pressure of the atmosphere. If you put water into a tube and heat the bottom, you give the particles a tendency to separate and fly apart from one another, and at a certain temperature they succeed in flying apart and form what is really a true gas, water, vapour, or steam, which, being lighter than the surrounding water, rises through it and disappears. Is it not plain, then, that if the pressure on the water is rendered less, we shall not have to heat the water so much to give this vapour an elastic force or tension sufficient to overcome the pressure? The lower the pressure to which the water is subjected, the less is the temperature to which we shall require to raise it in order to make its vapour overcome the remaining atmospheric pressure on it. I can illustrate that by experiment. I have here a flask which is connected by a flexible tube with the receiver of an air-

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pump, so that when the air-pump is set working, it will draw more or less of the air out of the flask, and, accordingly, I shall be able to put warm—not boiling—water into the flask, and submit it to a less pressure than that of the atmosphere. Before doing so, I must first put a few little bits of some metal into the flask, or else the water will boil very irregularly. Water boils in metal regularly, but in glass very irregularly and with great commotion; but by putting in a few fragments of metal you overcome this difficulty. This water which I put in the flask is hot, but still it is much below the boiling-point. Upon working the air-pump a few moments, as the atmosphere is withdrawn, the force which the vapour will have to overcome will become less and less, and presently the pressure will fall so low that the vapour of this merely warm water will be able to come away out of the liquid as freely as it could if I had been applying a powerful heat to the bottom of the vessel, and thereby increasing the tension of the vapour. This boiling of water under these conditions is a thing which everybody is acquainted with, but still it is one which I am bound to bring before you at this time, because it is the principle of the vacuum pan which I shall have to speak of hereafter.

From this point I may pass on to a few reactions and decompositions of sugar itself, which, I must mention, although they are somewhat tedious, admit of very few experimental illustrations which are visible at any distance. The precautions which are, or rather ought to be, observed in sugar-making depend on a knowledge of these decompositions, to which sugar is subjected when these precautions are not attended to. Sugar itself, in the purest form in which we have it, is a white crystalline body, sometimes occurring in very large crystals, composed of three elements only—carbon, hydrogen, and oxygen. The proportion in which they are united I need not trouble you with, but I may say that if other considerations allowed of it, we might regard it simply as a compound of carbon and water, the oxygen and hydrogen being in the same proportion as that in which they combine to form that liquid. When sugar is submitted to a variety of chemical actions, the first change which it submits to is a change of this kind, that the elements of water are either abstracted from it or are added to it. The changes which occur where water is removed from it may be illustrated thus:—When sugar is heated, it first melts, then, if the heating is continued slowly and regularly, it parts with one molecule of water, then with another, then another, and so on, becoming successively converted into a variety of bodies, the names of which I need not trouble you with, but which, I may remark, are all uncrystallisable, and not sweet, and passing at one stage into a mixture of bodies having very dark colour, which I dare say is known to most of you under the name of caramel. This conversion into a dark-coloured body, by the action of the heat, occurs, not only when sugar is heated by itself in a dry state, but also when it is heated for a long time in concentrated aqueous solution to a somewhat high temperature. If you take a very strong aqueous solution of sugar, and heat it in contact with a hot surface, a portion of it gets converted into this brown material, and colours the whole mass. One of the main improvements in the manufacture of sugar has consisted in evaporating the solution of that body at so low a temperature that this change of sugar into caramel can only take place to a very small extent. There is another change which I must refer to, of an opposite character, which consists in adding water to the molecules of sugar, not merely in the same way in which we add water when we dissolve it, but in a chemical sense, really adding water to its constituents. It is thereby converted into a mixture of two other bodies, very different in character, but having exactly the same composition. The one is known by the name of grape sugar, or dextrose, and the other under the name of fruit sugar, or levulose, specimens of which are on the table. These are the two substances which are produced by the addition of 1 molecule of water to a molecule of sugar; a change which can be effected only too easily in a variety of ways.

When a solution of sugar is heated, or only allowed to stand in an acid state, the change takes place; even very minute proportions of one of the mineral acids, such as sulphuric or hydrochloric acids, act with extreme rapidity, converting the valuable, easily crystallised cane sugar into a mixture of these two other sugars, which are uncrystallisable and comparatively worthless.

I have prepared such a mixture here by the action of dilute acid on a weak solution of cane sugar; and then by removing the acid employed, and by concentration of the resultant liquid I have obtained a body which is something like set honey. This change from cane sugar into that mixture of grape and fruit sugar is one which I cannot very readily illustrate, but I will endeavour, at any rate, to render evident that some change takes place. I will take here a solution of cane sugar, which I will divide into two parts. To the one I will add an alkaline solution of a copper salt, that is sulphate of copper dissolved in caustic soda by the aid of Rochelle salt, and which has, as you see, an intense blue colour. I add it to this solution of cane sugar, when you perceive the liquid remains blue, and on boiling it, unless the sugar was impure you will see no perceptible effect produced. I have boiled it, and the liquid is still of as bright a colour as before. Now, to the other portion, first diluting it, I will add one drop of hydrochloric acid, and heat it momentarily to the boiling-point, or hardly that; you will now see that a marked change has taken place, for, on adding some of the sugar solution so treated to another portion of the boiling blue copper solution, a bright-red colour of suboxide of copper is formed at once, and the liquid loses its blue tint. The action of a very small quantity of acid for a very short time has so utterly altered the nature of the sugar, that whereas while it remained in its original state it was incapable of action on this alkaline solution of copper, now, when it has once been submitted to that action, it exerts a startling influence; it has, in fact, taken oxygen away from the copper, so that whereas you may conceive that this blue solution contains protoxide of copper, a compound of copper, with a certain quantity of oxygen; in this red precipitate which is formed here we have a compound of the same quantity of copper with half as much oxygen, that is, half the oxygen of the copper is taken away by this altered sugar. Another way of illustrating this is by boiling a portion of unaltered sugar in solution, somewhat diluted with water, with a strong solution of caustic soda. We shall find that it undergoes no alteration if it is perfectly pure. You may find it turn a very little yellowish on account of an accidental impurity, but if it is quite pure no visible change whatever will take place. This I wish you to remark particularly, because one of the principal processes in the preparation of sugar from the sugar beet consists in heating the solution with a quantity of lime, which is, in its action, perfectly analogous to soda, being a very strong alkali. It exerts no action on cane sugar, but a very powerful action indeed on the altered sugar, or, as it is sometimes called, invert sugar. I will now repeat the experiment in the same form, only replacing the unaltered sugar by some which has been momentarily heated with a drop of acid. Both the new sugars are totally destroyed as sugar, and the whole liquid turns dark brown, almost black; in fact, the sugars are literally burnt up by the alkalies, although the true cane sugar submits to no alteration.

I must now show you another change which sugar undergoes, or rather, it is the same change as that which takes place when it is acted upon by acids, but produced by different reagents. You recollect that a solution of pure sugar, when boiled with an alkaline solution of copper, which has a brilliant blue colour, does not undergo any change. I will now get the solution of

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copper boiled, and add to it presently a solution of sugar which has undergone another alteration. I have here a solution of sugar which gives no reaction with this blue liquid; it is very gently warmed, about ordinary summer temperature, and I will add to it a small quantity of yeast, stirred up in water, and allow it to stand a minute or two. You know what yeast is—a body which rapidly produces fermentation in a decoction of malt or any sugary liquid. It will not, in this case, have time to induce fermentation, but it will have time, even in a few minutes, to produce the initial change of fermentation; the conversion of this crystallisable cane sugar into the uncrystallisable mixture of dextrose and levulose, the so-called inverted sugar. This copper solution is now boiling, and I must first show you that the yeast itself is not capable of producing precipitation. Being a cloudy body it will render the liquid rather turbid, but it does not precipitate the red oxide of copper, which, as I showed you just now, the altered sugar does in a ready manner. I have here a portion of the same blue liquid boiled in another flask, and now, after the sugar has been only a minute or two in contact with the yeast, on pouring some of it into the copper solution, you perceive the whole of the blue colour has been destroyed, and the liquid has turned red, owing to the precipitation of the suboxide of copper. The importance of these experiments is this, that it illustrates how excessively pernicious to a sugar-maker it must be to allow even incipient fermentation to occur. If the least trace of fermentation occurs, it inevitably causes the conversion of a very large proportion of valuable crystallisable sugar into the almost worthless uncrystallisable variety.

(To be continued).

PROCEEDINGS OF SOCIETIES.

ROYAL IRISH ACADEMY.

Monday, January 8th, 1872.

Prof. HENNESSY, F.R.S., in the Chair.

MR. C. R. TICHBORNE, F.C.S., read a paper "*On the Action of Heat upon Solutions of Hydrated Salts.*"

The author used for the examination of the dissociation of water of hydration, such salts as presented a change of colour when passing from the hydrated to the anhydrous state. He had experimented upon those of cobalt, copper, and nickel. Thus, to take the familiar instance of cobalt, the anhydrous salts of which are blue, whilst the hydrated are pink, no amount of boiling will convert a pink solution of cobalt into a blue one, except it is extremely concentrated, but in every case such salts were all changed into the anhydrous condition on boiling under pressure. When the "thermanalytic" point, as the author called t, was reached, the pink cobalt salts were converted into the blue ones, copper into yellowish-brown, and, in the case of chloride, nearly a black solution. Some caution is required in the performance of these experiments owing to the danger of an explosion. An important observation made in connection with these experiments was the fact that dilution acted differently in the cases of chromatic change produced by dehydration and those producing basic results. It is exactly the reverse. The author had pointed out in a previous report that chromatic changes resulting from the formation of basic salts by dissociation (*i.e.*, chromic or ferric salts) is influenced by dilution lowering the thermanalytic point, or the increase in volume of water will assist the dissociation. But in the second class the increase in the volume of water raises the thermanalytic point and retards the dissociation.

Prof. SULLIVAN complimented the author upon the importance of this investigation, and this line of research generally.

Prof. HENNESSY, F.R.S., &c., then read "*Some Notes of Observations of Phenomena in Optical Meteorology.*" These were descriptions of actual observations, particularly of one where a double rainbow was accompanied by what appeared to be vertical bands of light at a right angle to the horizon.

ROYAL GEOLOGICAL SOCIETY OF IRELAND.

THERE was a general meeting of this Society on Wednesday, the 10th of January, in the Museum Building, Trinity College.

The only geological papers were two by Mr. E. HULL, F.R.S., "*On the Marble of Carrara*," and "*On a Remarkable Fault in the New Red Sandstone of Rainhill*," Lancashire. These were not suitable for abstracts.

NOTICES OF BOOKS.

The Antiseptic System: A Treatise on Carbolic Acid and its Compounds; with Enquiries into the Germ Theories of Fermentation, Putrefaction, and Infection; the Theory and Practice of Disinfection, &c. By ARTHUR ERNEST SANSOM, M.D. Lond., M.R.C.P., &c. London: Henry Gillman. 1871.

STARTING with the end in view of detailing the several applications of carbolic acid, Dr. Sansom, like an observant traveller, does not immediately confine himself to the road he traverses, but carefully studies the theories and facts he meets with in his journey. His methodical study of theory whilst observing facts we cannot better illustrate than by extracts from the work itself. The practical nature of the work may be judged from the following:—

"*Disinfectant Powders.*—Since 1858 crude carbolic acid mingled with various substances, in the form of powder, has been used for disinfecting purposes.

"(1). The disinfectant powder of MM. Corne and Démeaux (1858 and 1859) consisted of plaster-of-Paris and coal-tar.

"(2). That of M. Bouchardat contained 1 part of carbolic acid in 1000 of plaster-of-Paris.

"(3). That of Parisel contained 1 part of carbolic acid to 100 of coarse meal, and 4 of lard or fat.

"(4). McDougall's powder contains about 33 per cent of carbolate of lime, 59 per cent of sulphite of magnesia, the rest being water.

"(5). Calvert's powder contains from 20 to 30 per cent of carbolic acid mixed with the powdered refuse from alum works.

"When one of these powders (the most efficient being probably the last two) are dusted over a putrescible mass, they prevent putrefaction by poisoning the germs in the air before they reach the mass. They thus filter the air of the elements which dispose to putrefaction. According to Dr. Parkes, half an ounce of either Calvert's or McDougall's powder will preserve four ounces of sewage from 18 to 21 days. . . . . Besides the influence of carbolic acid in these powders, I think their efficacy is probably due to another cause—their power of absorbing water from a moist, putrescible material."

Of the nature of the phenomena of putrefaction and fermentation Dr. Sansom says:—

"I have endeavoured, though I am well aware that the detail is imperfect, to present a faithful picture of the conditions of the questions of the origin of life and the nature of the phenomena of putrefaction and fermentation. It has been the fashion among many medical philosophers to regard the germ theory as a hasty generalisation from imperfect data. I believe I have adduced sufficient evidence to show that its supporters cannot be accused of impatience, that for earnestness of thought and zeal

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in experimentation they are not inferior to those who differ from them in interpretation.

"In these questions that latitude of opinion which the cultivators of science should never deprecate ought to be especially conceded by those who conscientiously take up the contest. Opinions concerning the force-attributes of matter will be various, according to the bias of the minds of men, and views that are distasteful may be repudiated with insufficient cause. But, given all this latitude, I consider that the germ theory, whilst nothing has been conclusively established against it, is so strongly supported by the convergence of different kinds of observation and different modes of thought, that a dispassionate observer cannot fail to receive it as that highest expression of probability that in biology constitutes a law.

"By germ theory I mean the doctrine that the decomposition of organic material, in the processes known as putrefaction and fermentation, is due to germs, and that these germs are minute particles of living matter derived from a pre-existing living parent.

"Concerning minor points and details there is much room for doubt, and much encouragement for future investigation. I myself incline to hold that the active agents in inducing the changes are vegetable, not animal structures.

"The motile bacteria and vibriones which are observed in the early stages of organic decomposition, inasmuch as they are so universally present that they cannot be considered special to any process, as they can be traced to no form of future development, but may be observed to live their term of life, to die, and to undergo putrefaction, like other organic materials; and as they may be observed in cases wherein all putrefaction is arrested—I consider to be non-essential to the processes of decomposition. On the other hand, I see that fungoid elements play an essential part in the processes; when they are present the phenomena are manifest, when they are absent the converse; agents which quench their vitality arrest the objective signs.

"Fermentations can, according to my view, be distinctly divided into two classes:—1. Fermentations in which there is no reproduction of the ferment. 2. Fermentations in which there is reproduction of the ferment.

"In the first class there is a mere re-arrangement of the molecules, usually without any violent change in the physical constitution of the substances acted upon. It comprises the changes induced by pepsine upon albumen, &c. It corresponds to the class "Fermentations à elements non figurés" of Gautier. The changes are produced by diastase upon starch, by emulsine upon amygdaline, by a soluble or quasi-soluble organic compound, and are not of necessity attended with the appearance of any organism whatever. The circumstance which abruptly divides them from the second class is this: that the ferment inducing them does not become multiplied and reproduced in the process, but tends rather to exhaust itself.

"A fragment of diastase will change a considerable quantity of starch into glucose, but when the change is completed a fragment of the resulting compound will not produce, upon succeeding portions of starch, a like change.

"In the case of alcoholic fermentation, on the other hand, the original power of inducing the fermentation is transmitted to the yeast through successive generations.

"The first class, then, includes fermentations not reproductive; and as the ordinary notions concerning fermentations associate with the process the idea of a reproduction of the ferment as an essential element, I think we should exclude these transformations from the category of true fermentations.

"True fermentation, in my opinion, is a decomposition of an organic material which has a certain uniformity of composition initiated by the vital acts of fungoid organism. Whether these organisms effect the whole decomposition by their acts of life '*purs et simples*,' or whether their activity once manifested, their influence in decomposition is multiplied by a quasi-catalysis, is, to my mind, a secondary question, as yet undecided.

"Putrefaction I consider to be a process analogous to fermentation occurring in a material of more complex constitution than obtains in the latter, or in a material of mixed composition.

"The initial changes are induced by fungoid organisms, which vary according to the material—as it comprises substances capable of the various kinds of fermentation. The material in putrefaction, however, affording a more fitting pabulum for forms of animal life, the complications due to the appearance, vital acts, and mutual decompositions of animalculæ, are superadded to make the process still more complex. The fœtor is chiefly due to the evolved sulphur compounds."

Having shown the power of carbolic acid to prevent fermentation and putrefaction, the author proceeds to ascertain its position amongst other agents which have like powers, and from the data that its chemical constitution is similar to the hydrocarbonaceous matter, which forms so much of the bulk of a fermentescible mass, and that its action is in no way explained by its chemical properties, Dr. Sansom draws the important conclusion, that the chemical constitution and the chemical properties of a body are in no direct relation whatever with the power of that body to arrest fermentive or putrefactive change.

MISCELLANEOUS.

Quality of the Metropolitan Gas.—Dr. Letheby, the chief Gas Examiner appointed by the Board of Trade, has recently submitted his Quarterly Report of the illuminating power and chemical quality of the gas supplied to London by certain of the gas companies; from which it appears that the average illuminating power of the common gas has ranged from 15·58 standard sperm candles in the case of the Imperial Gas at Camden Street testing place to 17·80 candles in that of the Chartered Company, at Friendly Place, Mile End; the average illuminating power of the Cannel gas of the last named company having been 24·93 candles. The amount of sulphur in the gas has ranged from an average of 21·03 grs. per 100 cubic feet of the Chartered Gas at Friendly Place to 40·3 grs. in the same company's gas at Gray's Inn Road testing place. In the corresponding quarter of last year the range was from 19·78 grs. per 100 cubic feet to 33·17 grs.; and in the case of the Cannel gas the average quantity was 28·54 grs. in the quarter which has just expired, while in the corresponding quarter of last year it was only 12·27 grs. at Cannon Street and 24·39 grs. at Arundel Street. The amount of ammonia in the gas has averaged from 0·09 of a grn. per 100 cubic feet to 1·22 grs.—the quantity prescribed by the referees being 2·5 grs.

The Effect of a Grain of Strychnine.—A man in Harrisburg recently attempted to commit suicide by taking a grain of strychnine. The skill of his physician having saved his life, he narrates his experience for the benefit of science. He says: "In the course of five minutes I began to feel slight cramps in the calves of my legs. The cramps increased in intensity and extended to the feet and thighs, causing the most intense pain. I attempted to rise from the chair, but fell to the floor with convulsions in the lower extremities. Unsuccessful attempts were made to bathe my feet in hot water, each effort to raise me bringing on violent paroxysms, in the last one of which I thought my jaws had become unhinged. I was now perfectly paralysed from the hips down, and suffering the most excruciating pains, which began to extend upwards; the muscles of the shoulders and neck were soon considerably convulsed, the forearms

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still being free from pain. I now prepared for the final struggle, which I knew must be near at hand, as I had become rigid from the neck down, save the forearms. The convulsions of the muscles were becoming fearful, and the torture awful to endure. My hands were drawn in to my sides, with the fingers drawn apart, and slightly bowed, and the jaws became rigid. I felt myself raised as if by some mighty power, and fixed immovably, with only my feet and head touching anything. I became unconscious of everything except my own agony, which was now beyond all description. I could feel my heart fluttering, and my brain beating and throbbing with an irregular motion, as though at every beat it would burst from its confinement. Every joint was locked, and every drop of blood seemed stagnated. I remember thinking it could not long be thus, when I must have lost consciousness. I remember nothing more until I felt a sensation of relief, as though the garments of death which had been drawn over me were being drawn back. Those terrible cramps seemed to be descending towards my lower limbs. A feeling of relief stole over me, and I began to be again conscious. From that time I resumed consciousness, when I was entirely free from cramps, with the exception of a little in the feet. I had but one attack of cramps afterwards, which was immediately relieved by a dose administered by my wife—the doctor having left for a short time—and when he returned, I felt that the poison was completely neutralised."—*Scientific American.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, December 11, 1871.

This number contains the following original papers relating to chemistry and collateral sciences:—

Third Memoir on the Discolouration of Flowers by Electricity; Cause of the Phenomenon.—Dr. Becquerel.

Intervention of Atmospheric Nitrogen in the Process of Vegetation.—P. P. Dehérain.—This lengthy essay contains the record of a series of experiments made by the author to prove that, by the assistance of carbonaceous matter in state of decomposition and present in the soil, nitrogen is absorbed from the atmosphere and made available for the plants.

Diffusion of Mercurial Vapours.—M. Merget.—After referring to the researches made by Faraday nearly half a century ago on this subject, the author of this exhaustive essay describes at great length a series of researches made by him on this subject, use being made of paper impregnated with the mixed chlorides of platinum and palladium as a delicate test for detecting the vapours of mercury. The volatilisation of this metal is continuous, and does not even cease when the mercury is solidified by cold; the vapours of this metal are possessed of a considerable diffusive force, and it would appear that this force is equal to that which is deduced *à priori* from the dynamical theory of gases. This important memoir contains, moreover, an account of a large number of scientifically and industrially noteworthy applications of the author's researches.

Composition of Native Phosphate of Lime Recently Quarried in the Départements de Tarn et Garonne and Du Lot.—A. Bobierre.—This paper records the results of a series of analyses of the materials just alluded to, and made with the view to aid the superphosphate makers. The native phosphate alluded to contains, on an average, in 100 parts:—Sand, 0·93; phosphoric acid, 38·32; total lime, 48·92; water (driven off at red heat), fluorine, chlorine, carbonic acid, oxides of iron and manganese, &c., together, 11·83; tribasic phosphate of lime, corresponding to the phosphoric acid, 83·3; excess of lime, 3·94.

Phosphate of Lime Deposits near Saint-Antonin and Caylux.—M. Trutat.—A geological paper, containing the record of the author's researches on the spot alluded to, and a communication on the probable origin of this deposit as due to organic anima[illegible]

The Part which Space Plays (sur le Rôle de l'Espace) in the Phenomena of Solution.—C. A. Valson.

Action of Chlorine on the Chloride of Isopropyl.—C. Friedel and R. D. Silva.—The iodide of isopropyl has been first converted into the chloride by heating it in a sealed tube along with bichloride of mercury. The very pure chloride of isopropyl thus obtained has been submitted to the action of chlorine, aided by direct sunlight; the two principal substances thereby obtained are liquids, one of which boils at 70°, the other at 96°; the sp. gr. of the former at 0° = 1·1125, and of the latter, 1·182; their formula is $C_3H_6Cl_2$.

Derivatives from the Chloride of Tollylen.—E. Grimaux.—The author states that he has tried to obtain the monochloride of tollylen by causing alcoholic caustic potassa solution to act upon the chloride (obtained by the action of chlorine upon methyl-toluen, C_8H_{10}), but, instead of the body the author expected to obtain, he got mono-ethyline of tollylenic glycol, $C_{10}H_{14}O_2$, by a reaction which is represented by the following formula:—

$$C_8H_8Cl_2 + KOH + C_2H_5OK = C_8H_8\left\{\begin{matrix}OC_2H_5\\OH\end{matrix}\right\} + 2KCl.$$

The substance alluded to is a limpid liquid, having an agreeable odour; it is insoluble in water, soluble in alcohol and ether, boiling at about 252°. Nitrated chloride of tollylen—

$$C_8H_7(NO_2)Cl_2 = C_6H_3(NO_2)\left\{\begin{matrix}CH_2Cl\\CH_2Cl\end{matrix}\right.$$

is a solid crystalline substance, fusing at 45°; it is very soluble in ether, also in alcohol; by the action of a concentrated aqueous potassa solution upon the chloride of tollylen there is formed a yellow-coloured substance, insoluble in all solvents, fusing at 275°.

Researches on the Physiological Properties of Various Metallic Chlorides.—Dr. Rabuteau.—A very important contribution to pharmaco-dynamics.

Combustibility of Carbon.—Dr. Dubrunfaut.—The author holds that carbon cannot burn unless by the influence of water, which is convert.d thereby into hydrogen and oxide of carbon, and further maintains that, as regards the phenomenon of combustion of carbon in dry oxygen gas, we are not acquainted either with pure or with dry gases.

Quantitative Estimation of Glucose.—F. Jean.—After first referring to the researches of Drs. Millon and Commaille on the reciprocal action of the proto-salts (red oxide) of copper and those of silver, the author communicates the following reaction:—1 decigrm. of sugar having been first converted into glucose, and this having been added to a solution of the double cupro-tartrate of potassa, the mixture is next boiled, whereby a precipitate of red oxide of copper is produced: this is then dissolved in hydrochloric acid, and next oversaturated with ammonia. The liquid so obtained is poured into ammoniacal nitrate of silver solution, whereby a precipitate of metallic silver is thrown down, which, having been weighed (the assay has been tried several times), is found to yield a result quite satisfactory for all purposes, because, while theory requires 0·315, the author obtained (with 1 decigrm.) 0·316, 0·315, 0·314, &c. 1 equivalent of glucose corresponds to 5 equivalents of metallic silver, or 100 glucose to 300 silver, and 100 cane sugar to 316 silver.

December 18, 1871.

This number contains, in addition to several very interesting papers on meteorology, the following original papers relating to chemistry and allied sciences:—

Memoir on Dr. J. von Liebig's Essay on Fermentation.—M. Pasteur.—Notwithstanding the intrinsic value of this very lengthy paper, it is not well suited for any useful abstraction.

Influence of Various Colours upon Vegetation.—P. Bert.—From this very important phyto-physiological essay we learn that the use of coloured glass bell-jars and coloured glass panes in hothouses is absolutely injurious to vegetation, and that plants only thrive healthily by obtaining a plentiful supply of white light (ordinary day- and sunlight).

Dolerite Met with in the Bergonne (a District of the Auvergne in France) Limestone Deposit, and on the Zeolites Found in that Locality.—F. Gonnard.—A mineralogical essay. We meet here with the results of the chemical analysis of the mesol from Gignat (the name of a village); that mineral contains, in 100 parts:—Silica, 42·3; alumina, 28·1; lime, 10·0; soda, 6·7; potassa, a trace; water, 14·1; total, 101·1.

Complex Nature of Cathartine.—E. Bourgoin.—After first referring to the researches made by Lassaigne and Fennelle in 1821 on the senna leaves, and allusion being made to the cathartine then discovered and considered to be the active principle of the drug alluded to, the author states that, having occasion to prepare cathartine, he has, on experimenting with it, found it to be made up of chrysophanic acid, a dextrogyre glucose, and chrysophanine. The cathartine, prepared as described by Lassaigne and Fenuelle, is first treated with ether, whereby the chrysophanic acid is eliminated; next, the residue is treated with water, whereby the dextrogyre glucose is dissolved; the chrysophanine is best obtained by treating the cathartine first with ether, next dissolving it in water, and precipitating that solution with acetate of lead, the chrysophanine combining with lead, and being set free by treating this lead compound with sulphuretted hydrogen. When, however, it is desired to obtain a large quantity of chrysophanine, it is best to work with a strong senna infusion, from which the mucilage is thrown down by means of alcohol, the clear solution next treated with neutral acetate of lead solution, further treatment with sulphuretted hydrogen, filtration, evaporation of the clear liquid to syrupy consistence, and precipitation with alcohol at

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90 per cent; the precipitate (crude chrysophanine) is purified by means of alcohol, until that liquid runs off colourless. The properties of chrysophanine will be described by the author in another paper.

Bayerisches Industrie und Gewerbe Blatt, October, 1871.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

International Exhibition at Moscow.—A. List.—This paper contains some particulars on the subject just mentioned. The exhibition will be opened on May 30 next, the 200th anniversary of the birth of Peter the Great; the scope and arrangement of this display is, in many respects, similar to the exhibition held at Amsterdam some years ago.

Continuation of the Report on the Swabian Exhibition Held at Ulm (1870).—A. Fischer.—This portion treats on metallic industry and engineering works; industry of textile fabrics; articles of food and diet; musical instruments and fine arts.

Revivification of Bone-Black in Sugar Refineries by the Aid of Ammonia, and the Use of a Peculiar Apparatus whereby the Re-Burning of the Bone-Black is Avoided.—Dr. H. Eisfeldt and C. Thumb.—This lengthy memoir, illustrated by a series of engravings, contains, in the first place, a detailed account of the various methods of bone-black revivifying and the *rationale* thereof, and, next, a complete description of the process and apparatus of the authors. From the summary review added to this essay, it appears that this plan of revivifying bone-black (it has been tried for some years already on the large scale in a few sugar works) is better and cheaper than any other.

Annales des Mines, No. 4, 1871.

This number contains the following original papers and memoirs relating to chemistry and collateral subjects:—

Memoir on some Minerals Found along with Smithsonite in the Mineral Deposits of Nador, Province of Constantine.—M. Flajolot.—Nadorite is a new mineral, $Sb_2O_3Cl.2PbO$; sp. gr. = 7·02; it is crystalline, readily soluble in hydrochloric acid, and contains, in 100 parts:—Lead, 51·60; antimony, 31·55; oxygen, 8·0; chlorine, 8·85. Antimonio-carbonate of lead; in 100 parts:—$Sb_2O_3Cl.2PbO$, 12·05; $Sb_2O_3.PbO$, 58·0; $CO_2.PbO$, 26·0; HO, 3·95. Antimoniate of iron, $Sb_2O_5.Fe_2O_3+1\frac{1}{2}HO$; in 100 parts:—Antimonic acid, 63·50; sesquioxide of iron, 31·40; water, 5·10. Arseniate of lead with chloride of lead: in 100 parts:—Arsenic acid, 18·30; oxide of lead, 53·60; chloride of lead, 8·55; carbonate of zinc, 13·50; carbonate of manganese, 1·10; carbonate of lead, 1·70; carbonate of magnesia, 0·70; oxide of iron and quartz, 2·20. Multiple clayey carbonate *(carbonate multiple argileux)*, a hard schistose mineral, perfectly homogeneous; in 100 parts:—Carbonate of protoxide of iron, 28·50; carbonate of zinc, 43·03; carbonate of protoxide of manganese, 5·10; carbonate of lime, 2·05; carbonate of magnesia, 2·10; hydrated alumina (alumina, 17·00; water, 2·20), 19·20. Smithsonite is calamine, a zinc ore which occurs in many districts of Algeria.

Metallurgy of Silver in Mexico.—P. Laur.—An exhaustive and very complete treatise on this subject. The author, having spent several years in the country alluded to, has obtained the best and really reliable information, also by locally viewing mines and smelting works attached thereto.

Polytechnisches Journal von Dingler, first number for December, 1871.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Extraction of Peat from Peat-Bogs according to the Diesbach System.—Baron von Lameran.—This paper, illustrated by engravings, contains a detailed description of a very important mode of working peat-bogs advantageously.

Part which Carbon Plays in the Making of Moulds for Iron Castings.—A. Ledebur.—This part contains a very excellent account of the iron-foundry industry.

Baryta Glass.—Dr. H. E. Benrath.—This lengthy essay treats on the chemistry of glass manufacture, and more especially on the use of baryta as a constituent of the glass mass; when in ordinary window-pane glass, $NaO,CaO6SiO_2$, baryta is substituted for a portion of the alkali, and some litharge added instead of lime, and this be done so that, according to equivalents, one-third of the alkali and half of the lime are left out, we obtain a glass mass, composed according to the formula—

$$(6KO+6CaO36SiO_2)$$
$$4KO,2BaO,3CaO,3PbO36SiO_2$$

The percentage composition of a glass mass made according to the lower formula will be—Silica, 60·0; oxide of lead, 16·6; lime, 4·6; baryta, 8·4; potassa, 10·4 (these two being equivalent to 14·3 potassa). The author communicates the results of a series of experiments made on the large scale, and elucidated by analysis. It appears that the celebrated glass manufacturer, P. Regout, at Maestricht, uses the following mixture for the production of an excellent and very brilliant glass:—Sand, 300 parts; potash, 80; nitrate of potash, 10; witherite (native carbonate of baryta), 40; limestone, 40; red-lead, 80.

Studies on Portland Cement.—F. Schott.—Notwithstanding the intrinsic value of this very exhaustive essay, its contents are not suited for useful abstraction; a remark equally applying to the following paper:—

Direct Manufacture of Ultramarine by One Calcination Process.—C. Furstenau.—Illustrated with engravings.

Decomposition of Nitro-Sulphuric Acid (Crude Sulphuric Acid which Contains Nitric and Nitrous Acids in Solution) by the Aid of Glover's Column, and on the Concentration of Sulphuric Acid to 60° B. Combined therewith.—F. Bode.—A critical review on the subject mentioned. The author partly approves of the arrangement, but says that, as long as it is possible to concentrate chamber acid by the heat of the pyrites-kilns, Glover's plan is not commendable in practice.

New Method of Estimating the Value of Aniline Dyes.—A. Muller.—The author describes at great length a process of testing the aniline dyes, based upon the fixation of the dye to be tested on a piece of plate glass by means of collodion, so as to form a thin layer of the dye under examination, which is then compared with a normal dye similarly prepared.

Composition of a so-called Infusoria Earth Recently Found near Altenschlirf (Hesse-Darmstadt).—Dr. Tasche.—The earth, dried at 100°, contains, in percentages:—Silica, 91·5; oxide of iron, 0·5; water and organic matter, 8·0.

Use of Olive Oil for the Purpose of Purifying the Carbonic Acid Evolved from Common Limestones, and also for the Purpose of Absorbing the Empyreumatic Matters by the Preparation of Liquid Ammonia from Tar-Water in Gas Works.—E. Pfeiffer.—The olive oil, partly imbibed by lumps of pumice-stone, and partly in fluid state, is used for the purposes alluded to, in order to retain empyreumatic matter which contaminates carbonic acid prepared from some kinds of limestones, and also to retain the empyreumatic products which are carried off when tar-water (ammoniacal liquor of gas works) is boiled for the purpose of producing liquid ammonia. The olive oil may be repeatedly used, for after having been strongly heated it loses the products it had absorbed, and the oil is at last always valuable for making cart-grease.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 18. 1871.

This number, published on January 8th inst., contains the following original papers and memoirs:—

The Affinity of Hydrogen for Chlorine, Oxygen, and Nitrogen.—J. Thomsen.—We regret that the contents of this very important essay do not omit of any useful abstraction. The following are the headings of the chapters into which this memoir is divided:—Affinity of hydrogen for chlorine; affinity of hydrogen for oxygen; affinity of hydrogen for nitrogen.

Synthetical Experiments on the Uric Acid Group.—O. Jacobson and A. Emmerling.—This lengthy memoir contains the following sections:—Action of cyanogen upon dry ammonia; action of water upon hydrazulmin at the ordinary temperature of the air; action of cyanogen upon aqueous ammonia; alteration which hydrazulmoxin undergoes by the action of hot water: synthesis of mycomelinic acid, oxidation of hydrazulmoxin; constitution of azulminic and mycomelinic acids, and of other uric acid derivatives.

Substitution of Aromatic Amines.—V. Meyer and O. Stüber.—This essay treats on the following question:—Since by the bromising (*Bromirung*) of aniline and acetanilid there is formed the 1·2 bromaniline, and since this compound is converted into dibromaniline, what is the constitution of the last-named compound? The contents of this paper, illustrated by complex formulæ, belong to the domain of constitutional chemistry.

On Tribrom-Aniline.—O. Stüber.—Tribrom-aniline, obtained by treating hydrochlorate of aniline with bromine, was gradually, and by small portions at a time, put into alcohol previously saturated with nitrous acid; hereby a strong reaction ensues, nitrogen and aldehyde being copiously disengaged, while, after cooling of the warm liquid, a crystalline solid body is obtained, which, by being re-crystallised from boiling alcohol, becomes colourless, exhibiting a substance fusing at 118·5°, difficulty soluble in cold alcohol, and not very largely so in that liquid when boiling. On being analysed, the composition of this substance was found to be identical with that of tribrom-benzol, but the position of the bromine atoms in this tribrom-benzol differs from that of the only hitherto known tribrom-benzol, which fuses at 44°.

Action of Nitrous Acid Ether upon Benzamide.—V. Meyer and O. Stüber.—When the aromatic amines are introduced into alcohol which has been previously saturated with dry nitrous acid (consequently, a solution of nitrous acid ether in alcohol), the group NH_2 of the amine is eliminated, and hydrogen directly substituted for it; taking aniline as an instance, this reaction may be elucidated by the following formula:—

$$C_6H_5.NH_2+NO.OC_2H_5=N_2+C_2H_6O+H_2O+C_6H_6.$$

By causing benzamide to react upon absolute alcohol, previously saturated with dry nitrous acid at 120° in a sealed tube, the result is the formation of benzoic ether and nitrogen, this reaction taking place according to the following formula:—

$$C_6H_5.CO.NH_2+NO.OC_2H_5=N_2+H_2O+C_6H_5.CO.OC_2H_5.$$

On Chloral.—V. Meyer and L. Dulk.—This very lengthy essay, elucidated by a series of complex formulæ, is divided into the following sections:—Introduction; action of chloracetyl upon chloral-alcoholate; acetyl-chloral-alcoholate is a colourless, oily liquid, exhibiting a pleasant smell, boiling at 198°; sp. gr. at 11° (as compared with water at the same temperature) = 1·327, formula; $C_6Cl_3H_9O_4$; action of acetic acid anhydride upon chloral.

On Tannic Acid and Some of its Derivatives.—H. Schiff.—The author first states that he has confirmed the observation made by Dr.

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Löwe some time ago, that arsenic acid converts at boiling heat aqueous and alcoholic solutions of gallic acid into tannic acid, while the arsenic acid is thereby left unchanged, unless the reaction takes place between the dry substances (gallic and arsenic acids) at a temperature of from 120° to 160°, when the arsenic acid is converted into arsenious acid; tannic acid thus prepared in its pure state has been further investigated by the author, who describes at great length and elucidates his experiments by a series of formulæ.

Preliminary Notice.—E. Ludwig.—Since H. Salkowski is, according to a paper published by him lately, engaged with experiments on the chinon-like derivatives of naphthol, a subject which is studied likewise by the author, we are informed that for the hydroxyl group in these bodies can be substituted the group NH_2 by the action of ammonia; oxynaphthochinon ($C_{10}H_5.O_2.OH$) yields by being treated at from 100° to 110° with aqueous or ammonia solution amidonaphthochinon ($C_{10}H_5.O_2.NH_2$).

On Amido-Benzo-Sulpho Acid.—L. Pratesi.—The remnant of the dry distillation of a combination of sulpho-phenol acid and aniline yields to water a substance which, on being further investigated, is a body with acid reaction, and forming salts with potassa, soda, oxides of lead and copper, and, by treatment with bromine, tribromaniline; this compound is, therefore, amido-benzol-sulpho acid,

$$C_6H_4 \begin{cases} NH_2 \\ SO_3H. \end{cases}$$

On Aurin.—R. S. Dale and A. Schorlemmer.—Second paper on this subject. Aurin very carefully purified and dried at 200° has the formula $C_{20}H_{14}O_3$, and accordingly its mode of formation may be elucidated by the following formula:—

$$3C_6H_6O+C_2O_4=C_{20}H_{14}O_3+2H_2O.$$

Pure leukaurin is best obtained by the action of powdered zinc upon an acetic acid solution of aurin; the formula of leukaurin is $C_{20}H_{16}O_3$. Aurin forms a compound with sulphurous acid and with the alkaline sulphites, while, when aurin is heated to 140° along with alcoholic ammonia solution, so-called red coralline is obtained in beautifully crystalline shape.

From the report of the proceedings of the General Annual Assembly of the German Chemical Society at Berlin we learn that the number of members (Fellows) on the 14th of December last was 720, of whom 136 reside at Berlin; the financial position of this Society is excellent.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, September and October (double number), 1871.

This number does not contain any original papers relating to chemistry.

NOTES AND QUERIES.

Sprengel Mercurial Pump.—(Reply to "M.")—See CHEMICAL NEWS, vol. xvii., p. 85. Also *Journal of the Chemical Society*, 1865.

Paraffin Oil and Paraffin Refining.—"M. P. S." will find the most useful information on these subjects in the latest edition of Ures "Dictionary of Arts," I think under the various headings of Paraffin, Photogen, &c., but in no book will he get any but a very faint idea of how the thing is done practically.—CHEMICUS.

Olive Oil Residues.—"Oleum" wishes to know where and how he can obtain olive oil residues. I paid some attention to this subject while in Italy, and found it a most difficult material to remove to any distance, as after pressure in that climate fermentation so soon sets in. In one province in South Italy, 30,000 tons of this residue may be obtained, containing, amongst other products, stearate and margarate of glycerine.—T. COBLEY.

Phenyl-Citramic Acid.—I find in Naquet's "Chemistry," that phenyl-citramic acid contains the elements of—

$$(C_{12}H_9O_{10})(C_{12}H_8)H,N_2.$$

I fancy it should be one N instead of N_2. Will any one having a French edition kindly state what is the notation given.—S. E. P.

Paraffin at High Boiling-Point.—Can you or some one of your numerous readers inform me, through the medium of your "Notes and Queries," what the name is of a certain paraffin oil (mentioned in one of your former numbers) that will bear a temperature of 1100° F., without boiling or decomposing; also where I can obtain some. I think it was discovered about June or July, 1870.—MEDICUS.

Softening Water by means of Lime.—In the "Chemical Notices from Foreign Sources" in the issue of the 12th inst., is a short *precis* on this subject. May I enquire price of the journal in which it appears (*Polytechnisches Journal von Dingler*), and where a copy can be obtained? With the late Dr. Clark's patented process of treating water containing carbonates with lime I am well acquainted; can your readers tell me if it has ever been attempted successfully to treat waters hard from gypsum and magnesic sulphate, and if any scheme for the purpose has been patented?—W. R.

A. H. Elliott's Method for Sulphur in Cast-Iron.—(Reply to S. Peters).—I used this process along with Wöhler's chlorine method, and also the method in which $CuCl_2$ is used and the C burnt in O, and I found it more easy to work, and that it gave more concordant results, than either of these; the precautions published in my paper were all that I found it necessary to attend to. The samples of iron that I worked with did not contain much combined carbon. With regard to the residual sulphur not evolved as H_2S, this will be found to be practically nothing if he weighs the $BaSO_4$. With regard to the questions about vanadium and titanium, my experiments did not lead me in their direction.—A. H. ELLIOTT.

MEETINGS FOR THE WEEK.

MONDAY, Jan. 22nd.—Royal Geographical, 8.30.
—— London Institution, 4. Prof. Odling, F.R.S., on "Elementary Chemistry."
TUESDAY, 23rd.—Royal Institution, 3. Dr. W. Rutherford, F.R.S.E., "On the Circulatory and Nervous Systems."
—— Civil Engineers, 8.
WEDNESDAY, 24th.—Geological, 8.
—— Society of Arts, 8.
THURSDAY, 25th.—Royal, 8.30.
—— Philosophical Club, 6.
—— London Institution, 7.30. Prof. Ella, "On Devotional and Dramatic Music."
—— Royal Institution, 3. Prof. Odling, F.R.S., "On the Chemistry of Alkalies and Alkali Manufacture."
FRIDAY, 26th.—Royal Institution, 9. The Archbishop of Westminster, "On the Demon of Socrates."
—— Quekett Microscopical Club, 8.
SATURDAY, 27th.—Royal Institution, 3. Wm. B. Donne, "On the Theatre in Shakespeare's Time."

TO CORRESPONDENTS.

G. G.—The English edition of Wagner's "Chemical Technology" will shortly be published by Messrs. J. and A. Churchill.

S. O. Hoffmann.—Received.

Chemicus.—(1). It is made from the Stassfurt mineral. (2). It depends entirely upon the water used. (3). Dry sifted ashes are sometimes employed.

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THE

MANUFACTURE OF CHLORINE.

ALTHOUGH the development of the process for the Manufacture of Chlorine by means of oxides of manganese regenerated by means of magnesia, to which reference was made on this page some months ago, has been sorely delayed by serious ill-health on my part, I am nevertheless in a position to announce that that process, in a certain modified form which it has now assumed, has proved capable of yielding even more advantageous results than I formerly claimed for it. It will necessarily be yet some time before I can be able or free to supply working details. Meanwhile, I beg to report as follows :—

I. That the new form of process yields, in the free state, practically *all* the chlorine contained in the salt decomposed, being at about the rate of *a ton of bleaching-powder per fourteen hundredweights of salt.*

II. That, of the chlorine which it thus yields, a sufficient proportion to give a ton of bleaching-powder for about each thirty hundredweights of salt is ENTIRELY UNDILUTED, and therefore available for the manufacture of bleaching-powder in the chambers at present in use. This portion of the chlorine is generated in the ordinary (Weldon) stills, and is in precisely the same condition as that produced in my process as at present practised, or as that generated by means of native manganese.

III. That, while the remainder of the chlorine is *dilute*, it is not more so than that produced in any process yielding dilute chlorine only, and is free from carbonic acid, the sole diluent being nitrogen.

IV. That the process, in its new shape, is performed without blowing engines, and *without machinery of any kind*, by appliances already in use in every alkali-work, the only thing employed in it which has any "moving parts" being an ordinary liquor-pump.

The new form of process thus yields more *strong* chlorine, per given quantity of salt, than has ever hitherto been produced by any process whatever, and, in addition, yields the remainder of the chlorine in as good a state as the richest chlorine producible by any process which yields dilute chlorine only. While permitting the present production of bleaching-powder, per given quantity of salt, to be nearly *quadrupled*, it enables one-half of the quadrupled production to be made from undiluted chlorine, in such chambers as have been employed hitherto, and one-half of the chlorine to be generated in the present stills. Putting the whole cost of the process on the *strong* chlorine only, the cost of the latter, per ton of bleaching-powder, promises to be lower than it has ever been yet, the other half of the chlorine counting as not costing at all. Lastly, the special plant required for the new form of process is so simple and inexpensive, that the cost of a plant for any considerable production will probably not exceed £20 for each ton of bleaching-powder to be made by it per week.

WALTER WELDON.

OFFICES OF WELDON'S CHLORINE PROCESSES COMPANY, (LIMITED),
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December 12th, 1871.

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THE CHEMICAL NEWS.

VOL. XXV. No. 635.

ON THE

REACTION OF CHLORAL HYDRATE AND SULPHIDE OF AMMONIUM.*

By Dr. I. WALZ.

IN 1847 Liebig and Wöhler obtained a peculiar crystalline and well-defined base, called thialdine, by passing a current of sulphuretted hydrogen through a solution of aldehyde-ammonia. It was to be expected that in a similar manner an analogous substance might be obtained from the action of sulphuretted hydrogen upon a solution of chloral hydrate in ammonia, or, what amounts to the same thing, of sulphide of ammonium upon a solution of chloral hydrate. In fact, Staedeler announced in the form of a preliminary communication that he had succeeded in isolating this substance; but since that, nothing has been published upon the subject, as far as I am aware.

About a year ago I made a number of experiments in this direction, which have not led to any very satisfactory results, and which I am only induced to communicate because I am in hopes that they may lead to a simple and easy test for the purity of chloral hydrate, which, in view of repeated recent accidents consequent upon the administration of this preparation, would be highly desirable. And in this place let me protest against the uniform neglect, in nearly all the cases reported, of a chemical examination of the suspected medicine. I am far from asserting that the medicinal use of even pure chloral hydrate may not, in certain diseases, or to certain constitutions, prove deleterious; but it would certainly go far towards a definite settlement of this disputed question, if, in a number of authenticated cases, the degree of purity of the chloral administered were ascertained by chemical tests. In this, as in many other cases, science and humanity would be greatly benefited by a closer co-operation between the physician and the chemist.

The chloral hydrate which I used at first in my experiments was of American manufacture, a little moist as it came from the factory, and was kept in my laboratory in a glass-stoppered vial during almost the whole of the unusually warm summer of last year. Unfortunately, I had no reason to suspect it till it was all used up. I dissolved it, in several portions, and at different times, in about 15 to 20 times its weight of water, to which a little ammonia had been added, and as soon as the solution had been effected, I added an excess of sulphide of ammonium. The liquid assumed a reddish-brown colour, and an abundant yellow precipitate was formed. This was thrown upon a filter, washed with cold water, and dried over sulphuric acid. It then formed a light yellow, impalpable powder, which became electric when rubbed in the agate mortar. It is insoluble in dilute acids, alkalies, and alkaline sulphides, sparsely soluble in alcohol, ether, bisulphide of carbon, and turpentine. When boiled with hot alcohol it seems to undergo partial decomposition, as crystals of sulphur were obtained from the solution. Concentrated sulphuric acid dissolves it; by the addition of water it is precipitated unchanged. Concentrated nitric acid oxidises it rapidly, forming at the same time a volatile oil of very pungent odour, and powerfully irritating to the eyes. It seemed to be most soluble in chloroform, from which solution it was obtained as a yellow résinous crust. When heated in a porcelain crucible, a heavy dark yellow oil of very disagreeable odour comes off, a shining, black, porous coal remaining behind. I could not analyse it for want of material; but it appeared to be a well-defined substance, and when I shall obtain suitable material I will prepare it again, and subject it to analysis. In the meantime I will state that O. Loew asserts, that in physical appearance and chemical properties it resembles exactly the sesquisulphide of carbon, which he described in the *American Journal of Science*, xli., 363.

In order to obtain a larger quantity of this substance, I procured from Dr. P. Schweitzer a sample of chemically pure chloral hydrate of his own preparation. With this, the result of the sulphide of ammonium reaction was quite different. The liquid turned red, then rapidly brown and thick, depositing, in the course of 24 hours or longer, a glutinous, dirty brown substance. If, however, the liquid is acidulated soon after the commencement of the reaction with hydrochloric acid, a grayish-brown flocculent precipitate is obtained, mixed with sulphur. This precipitate, dried over sulphuric acid, is a harsh powder, and the raw substance contained in it difficult to obtain pure. Chemically, it seems to be closely related to the yellow sulphydrine above described. The filtered hydrochloric acid solution has an agreeable odour of stewed kidneys, and, on standing, deposits an orange or dark yellow substance, related to the two former.

There can be no doubt that the chloral hydrate which I had at first was either impure or decomposed by moisture, heat, or light. I would request those who may have occasion to test chloral hydrate, to apply the sulphide of ammonium, in order to ascertain whether the reactions described are sufficient to establish the purity or impurity of the substance. The reaction may be made in a test-tube, and with a comparatively small quantity of the chemical.

* Read before the Lyceum of Natural History of New York.

ASSAY FOR GOLD AND SILVER.

By T. M. BLOSSOM, E.M.,
Assistant in charge of the Assay Laboratory of the School of Mines, Columbia College.

(Continued from vol. xxiv., p. 270).

II. ASSAY OF ALLOYS.

1. *Silver Coin and Bullion.*

THE form of assay used for silver coin and bullion is that known as Gay-Lussac's Wet Method, which consists in determining the fineness of the alloy by the quantity of a standard solution of common salt necessary to precipitate, fully and exactly, the silver contained in a known weight of alloy.

The process embraces two steps—

A. Preliminary Assay, and *B*. Assay Proper.

The latter requires for its conduct the preparation of three solutions called—*Normal Salt*, *Decime Salt*, *Decime Silver*.

Normal Salt Solution.—This is a solution of common salt of such a strength that 100 c.c. will precipitate exactly 1 grm. of silver. (Preparation below).

Decime Salt Solution.—This is a solution of common salt only 1-10th the strength of the former, *i.e.*, 100 c.c. will precipitate exactly 0·1 grm., 1 c.c. will precipitate 1 milligramme of silver. The solution is made by diluting 1 part of the *normal salt* with nine parts of pure water.

Decime Silver Solution.—Dissolve 1 grm. pure silver in nitric acid, and dilute to a litre. 1 c.c. of the solution will contain 1 milligramme pure silver. The *decime silver* is equivalent to the *decime salt*, *i.e.*, if mixed in equal quantities they will mutually suffer complete decomposition.

Preparation of the Normal Salt Solution.—A large quantity of the solution is prepared at one time and prepared at one time and preserved in a suitable vessel, partially closed in such a manner as to prevent any alteration in the strength of the solution through loss of water by evaporation. Let us suppose that a common glass

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carboy, of 60 litres capacity, is employed, and that it has affixed to it a scale, carefully graduated, to indicate its contents at any time. We will add only 45 litres of water, in order to leave sufficient room for agitation of the solution after the addition of salt. How much salt must be added to 45 litres of water to make the solution of the required strength? If pure salt be employed, the answer is easily found by the following proportion:—

$108 : 58{\cdot}5 :: 45 \times 10 : x = 243{\cdot}75$ (grms.) = wt. of pure salt.

Pure salt, however, is difficult to procure, and alters rapidly by the absorption of moisture, so that we generally employ a concentrated solution of common salt. The quantity of salt it contains may be ascertained by evaporating a portion to dryness. Let us suppose that 100 c.c. of the concentrated solution contains 35 grms. of salt. We require, as found by the above proportion, 243·75 grms. pure salt for 45 litres pure water.

$(223{\cdot}75 \div 35) + 100 = 696{\cdot}29$ = number of c.c. salt solution. Since, in adding the salt, we also introduce 696·29 c.c. water, we will put into the carboy 45 litres less 696·29 c.c., or 44 litres, 304 c.c. water. The water and salt solution having been introduced, they must be well mixed by means of an agitator. The tubes and pipette are washed out several times by allowing the solution to run through them; the solution so passed is returned to the reservoir, and the contents are agitated after each addition. The solution is now tested and accurately standardised. We have prepared for this purpose three or four solutions of silver in nitric acid, called check-assays, each containing 1 grm. pure silver, The solutions are made with strong acid in glass-stoppered bottles of 8 oz. or 250 c.c. capacity. The stoppers must fit perfectly, to prevent loss of solution on shaking the bottles. Prepare also a temporary decime salt solution by diluting 25 c.c. of the normal salt solution with nine times the quantity or 225 c.c. of water. This will not be exactly equivalent to the decime silver solution, but the error is very slight, and may be disregarded.

For the sake of convenience, we consider the pipette of 100 c.c. to be divided into 1000 parts. Since 100 c.c. = 1 grm. pure silver, 1 thousandth will correspond to 1 milligramme silver, and will equal in strength 1 c.c. of the decime salt solution. Cubic centimetres of the decime salt and the decime silver are also called thousandths, because the former equal, and the latter correspond to, thousandths of the normal solution.

Run into one of the check-assays 100 c.c. of the normal solution, agitate, and allow the precipitated chloride of silver to subside. Repeat the agitation, if necessary, until the solution settles clear and bright. Add now 2 thousandths of the decime salt solution. Since the common salt contains impurities, there will not be enough salt in 100 c.c. of the normal solution to precipitate 1 grm. silver, and the decime salt will produce further precipitation. Agitate as before, and, when the solution becomes clear, add again 2 thousandths decime salt, and repeat the operation until a precipitate fails to appear on the addition of the salt solution. Suppose we have added altogether 16 thousandths. The last two produced no precipitate and are not counted. The two preceding thousandths were needed only in part, so that the acting thousandths were above 12 and below 14, or 13 in number. Thus 1013 parts of the normal solution are required to precipitate 1 grm. silver, while only 1000 should be required. The solution is too weak, and the quantity of salt solution to be added may be found by considering that 696·29 c.c. have produced a standard of only 1000 − 13 or 987 thousandths. It remains to provide for the 13 thousandths. The additional quantity of salt solution required is found by the following proportion,—

$987 : 696{\cdot}29 :: 13 : x = 9{\cdot}2$ c.c.

9·2 c.c. of the concentrated salt solution are added to the reservoir, and the contents are well mixed. The tubes and pipette are washed out with the new solution, and another test is made precisely as before, except that we add 1 thousandth of the decime salt, at a time, instead of 2 thousandths. Suppose we have added 2 thousandths of the decime salt, the first one alone producing a precipitate. We require then somewhere between 1000 and 1001 parts of the normal solution, or about 1000·5. Add 2 thousandths of the decime silver solution. These will decompose the excess of salt solution, or 1·5 thousandth, and leave 0·5 thousandth decime silver in excess. Add 0·5 thousandth decime salt; this will give a precipitate, but a second 0·5 thousandth fails to produce one. We require of the normal solution, therefore, a number of thousandths between 1000 and 1005·5, or 1000·25, which gives a standard of $100 - 0{\cdot}025 = 999{\cdot}75$, which may be considered sufficiently near for most purposes.

Greater accuracy may be obtained, if desired, by adding a fresh supply of salt solution as indicated by the proportion—

$999{\cdot}75 : (696{\cdot}29 + 9{\cdot}2) :: 0{\cdot}25 : x = 0{\cdot}2$ c.c.

A new decime solution of salt is made from the standardised normal solution.

A.—*Preliminary Assay.*

This is a simple cupellation of the alloy with pure lead, to determine the approximate fineness. If we know the latter, this assay is, of course, unnecessary. It is rendered necessary in all other cases, by the fact of our employing in the assay proper, a constant volume of normal salt solution corresponding to 1 grm. pure silver, so that we must take such a weight of the alloy as will contain at least 1 grm. pure silver. The preliminary assay enables us to calculate this weight.

Pure lead-foil is kept, for gold and silver bullion, in small sheets about 2 inches square, weighing $\frac{1}{100}$ oz., or 5·287 grms. each. Weigh out 1 grm. of the alloy, wrap it up in a whole sheet of lead, and cupel in the ordinary manner. Suppose we obtain a button of silver weighing 0·8695 grms.; then—

$1 : 0{\cdot}8695 :: 1000 : x = 869{\cdot}5$ = approx. fineness.

This must be corrected for the unavoidable losses of a fire-assay. The following table, from Mitchell, gives the corrections to be made in the different standards, as found by cupellation. The corrections are given in thousandths, and are in all cases to be added to the standard by cupellation.

Table of Corrections for Loss in Cupellation.

Standard.	Corr.	Standard.	Corr.	Standard.	Corr.
998·97	1·03	670·27	4·73	346·73	3·27
973·24	1·76	645·29	4·71	322·06	2·94
947·50	2·50	620·30	4·70	297·40	2·60
921·75	3·25	595·32	4·68	272·42	2·58
896·00	4·00	570·32	4·68	247·44	2·56
870·93	4·07	545·32	4·68	222·45	2·55
845·85	4·13	520·32	4·68	197·47	2·55
820·78	4·22	495·32	4·68	173·88	2·12
795·70	4·30	470·50	4·50	148·30	1·70
770·59	4·41	445·69	4·31	123·71	1·29
745·38	4·52	420·87	4·13	99·12	0·88
720·36	4·64	396·05	3·95	74·34	0·66
695·25	4·75	371·39	3·61	49·56	0·44
				24·78	0·22

The number in the column of standards next nearest to 869·5 is 870·93, and the corresponding correction is 4·07: adding this to 869·5 we obtain 873·57 for the true approximate fineness. The difference between any two successive corrections being a small amount, it will be sufficient, in most cases, to take the correction for the next nearest number, when the exact standard is not found in the table. If greater nicety be desired, a third column of differences, as in logarithmic tables, may be constructed from the above table.

B.—*Assay Proper.*

Take such a weight of the alloy as will contain 1 grm. pure silver. This is found from the approximate fineness and by the following proportion:—

$873{\cdot}57 : 1000 :: 1 : x = 1{\cdot}145$ (grms).

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Having weighed out this amount, place it in a glass-stoppered bottle of 8-oz. capacity, and dissolve in about 10 c.c. nitric acid. Heat gently on the sand-bath to facilitate solution. Add 100 c.c. normal salt solution, and proceed as in testing the normal solution, until the decime salt fails to give a precipitate. Suppose we have added 6 thousandths of the decime salt. The last gave no precipitate, so that we required more than 4 and less than 5, or 4·5 thousandths. If greater accuracy be desired, proceed as follows:—Add 1·5 thousandths decime silver solution; this will decompose 1·5 thousandths of the decime salt which were added in excess; we know that 4 thousandths decime salt were required in totality; the fifth gave a precipitate, but was only required in part; we have decomposed the sixth and half the fifth by an addition of 1·5 decime silver; if now we add 0·5 thousandth decime silver and obtain a precipitate, we know that we required between 3 and 4·5 or 4·25 thousandths decime salt. If we obtained no precipitate with the half thousandth of silver, the first calculation of 4·5 would thus be proved correct. Suppose, however, that we obtained a precipitate; the number of thousandths salt solution required would be 1000 (normal) +4·25 (decime) = 1004·25, *i.e.*, the weight of alloy taken contained exactly 1004·25 milligrammes, equal to 1·00425 grms. of fine silver. The fineness is given by the following proportion :—

1·145 : 1·00425 :: 1000 : x = 877·07 (fineness).

(To be continued).

RELATION BETWEEN THE SPECIFIC HEAT AND THE ATOMIC WEIGHT.

By P. H. VANDER WEYDE.

DULONG and Petit were the first who, in 1819, pointed out the curious fact that, when the numbers representing the specific heat of elementary substances were multiplied with those representing their atomic weights or chemical equivalents, products are obtained which are equal to within a small fraction. So taking the specific heat of the substances mentioned, and muitiplying it with their atomic weights, we obtain the following table :—

Elementary substance.	Specific heat.	Atomic heat.	Product of number of the two former columns.
Mercury	0·033	100	3·30
Gold	0·032	98	3·13
Silver	0·057	54	3·07
Copper	0·095	32	3·04
Iron	0·110	28	3·08
Sulphur	0·200	16	3·20

If the value of atomic weights of many substances are doubled, as for good reasons is done at the present day, the products are, of course, also double that given in this table and all approximately = 6, in place of nearly =3, as is here found to be the case.

A similar relation to that which Dulong and Petit discovered for the elementary substances was found by Neuman in 1831 for compounds; for instance, in the case of sulphates and carbonates, he found for the following minerals:—

Mineralogical name.	Chemical name.	Specific heat.	Atomic weight.	Product.
Anhydrite	Sulphate of lime	0·185	68·0	12·6
Celestin	,, strontia	0·135	92·0	12·4
Heavy spar	,, baryta	0·108	116·0	12·5
Lead vitriol	,, lead	0·085	151·0	22·8
Iceland spar	Carbonate of lime	0·204	50·0	10·2
Iron spar	,, iron	0·182	58·0	10·5
Zinc spar	,, zinc	0·171	62·6	10·7
Witherite	,, baryta	0·107	98·5	10·5
White lead ore	,, lead	0·081	133·5	10·8
Strontianite	,, strontia	0·144	73·8	10·6

Two questions suggest themselves from the above details in every philosophically inclined mind. First: Are these coincidences merely accidental? Secondly: If not accidental, what do they mean? Is there some natural law at the bottom of these remarkable relations?

In regard to the first question, it must be remarked that the law appears quite general, and the exceptions very few, therefore accident is out of question; besides, the small differences in the products are easily accounted for by the fact that the specific heats differ at different temperatures, and for different physical conditions of the substances under investigation; while it is very significant that, in proportion as the experiments were made more carefully, the numbers calculated became more and more equal, as Regnault has pointed out.

In regard to the second question, as to the cause of this peculiarity, we have only to recall the numbers previously given, which show that 30 lbs. mercury, 17 silver, 10·5 copper, 8·75 iron, and 5 sulphur, possess at the same temperature the same amounts of heat; and to remark that these numbers are very nearly in proportion to one another as the respective atomic weights of the substances, 100, 54, 32, 28, and 16. As now these numbers express the combining equivalents, so that, for instance, 100 lbs. of mercury will combine with 16 of sulphur and form vermillion, and as we have reason to suppose that, in this case, like in others, each atom of mercury combines with an atom of sulphur, it is more than probable that 100 lbs. of mercury contain as many atoms as 16 lbs. of sulphur. If the number of atoms in these two quantities of mercury and sulphur is the same, and the amounts of specific heat the same, it is clear *that all atoms must possess the same specific heat.* This, now, is the law which lies at the foundation of the remarkable property explained.

When applying the modern theory, that heat is only a mode of motion, to the fact that all single atoms possess the same specific heat, it follows that it takes the same motion-producing force to increase the atomic oscillation (that means, raise the temperature) of every atom, be it mercury, sulphur, iron, or any other substance of this series of elementary substances; and that it takes a greater force (more heat) to increase the oscillation of the compound atom of a carbonate, and still more of a sulphate, &c.

"When these bodies lose their heat" means in the modern language of the conservation of force, nothing but that they communicate their atomic motion (oscillating or otherwise) to the atoms or the surrounding bodies, and put them in the same motion as they possess themselves, losing an equal amount of their own motion. Or conditions may be so arranged that this atomic motion (heat) is changed into motion of masses, commonly called force; of this arrangement, the steam-engine is the great type and example for further development.—*Scientific American.*

ON THE MANUFACTURE AND REFINING OF SUGAR.*

By C. HAUGHTON GILL.

(Continued from p. 31).

LECTURE II.

AFTER giving a brief recapitulation of the points mentioned in the previous lecture, Mr. Gill proceeded as follows:—

Time will not allow me to dwell longer on the chemical reactions of sugar, and I must now pass on, and give you an outline of the process of manufacturing sugar from the cane. As I stated last time, I have no first-hand knowledge of this process, and consequently can only give you an outline description, referring you

* The Cantor Lectures, delivered before the Society of Arts.

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to others for exact technical information. The sugar-cane, which you have all seen, either in the Botanical Gardens or represented in drawings, I need not stay to describe; it is a species of grass growing to a height of from six to ten feet. When ripe it is cut; the tops are lopped off, and the canes, tied up in bundles, are carried to the mill. The process most usually employed for extracting the juice from the cane is a very rough mechanical operation. The canes are brought up to a set of three rollers, so placed as to form two pairs, the first being set wider apart than the second, so as to only just bruise the canes, whilst they get a much severer pinch on passing through the second pair. The juice, being thus squeezed out, falls into the bed-plate of the mill, and from thence is carried to the pans in which it is clarified before being boiled down, whilst the trash or cane residue is dried and used as fuel. The juice is carried first to a series of large round vessels of about 400 gallons' capacity each, where it is brought nearly to the boiling-point, and treated with a small quantity of lime, to neutralise the acid and to assist in making the albuminous constituents set, so as to form scum which it is possible to remove. The juice, which was previously of much the same dark colour as the beet-root juice which I showed you last week, leaves these clarifiers transparent and of a more or less pale yellow colour. From these defecating pans the juice now goes to the first and largest of a series of hemispherical pans, bedded in brickwork and having a flue passing beneath them, from a furnace close to the smallest pan of the series to the chimney shaft at the other end.

The clarified juice goes, as I said first, into the largest vessel, where it is boiled until a considerable proportion of the water has been driven away. When another lot of juice is ready to come on, the contents of the pan are ladled into the second, and so it is gradually ladled from one pan into another until it comes to the smallest vessel, called a "teach," which lies immediately over the fire. By this time it has got very thick indeed, being about the consistency of treacle; and you can imagine very easily what must happen to it after all this work.

The cane juice which runs from the mill is slopping about over the place; bits of dirt, &c., have time to accumulate, and it turns a little sour; in fact, the whole juice, to begin with, is rather acid, and a portion of it begins to ferment. A change (such as that which I illustrated last week with the yeast) takes place to some extent, and a portion of crystallisable sugar is "inverted." When the juice goes into this pan it is still slightly acid, and, as I showed last week, the action of acid at a high temperature is to convert another portion of the sugar into that uncrystallisable modification, and the longer the action is allowed to go on the more sugar is thus converted. The juice is a long time passing from the first pan into the last, and therefore there is plenty of opportunity for this change to take place. Again, a high temperature is prejudicial to the sugar, as it destroys the crystallisable power of a portion of it; and, moreover, destroys another portion altogether as sugar. When the sugar has got as far as the last and smallest pan, it is so thick that it will not boil in the open air at a temperature of less than about 230° to 235° F.; this is a temperature at which it is subject to great alteration and decomposition, and not only so, but we must also consider how much higher a temperature part of it is really being subjected to. Every mistress of a family knows perfectly well that thick things, like starch or soups, will "burn" if not kept stirred; and you can readily understand why that is. They do not move about freely enough in the pot to get heated equally throughout. The bottom of the pot gets exceedingly hot, the fire upon which it is placed being three or four times as hot as boiling water, and any liquid which is pasty or thick, such as this sugar juice, cannot move freely, and flow up from the bottom, so as to cause a continual renewal of the parts exposed to the heated surface. Some portion, therefore, remains too long in contact with the highly-heated metal, and gets burnt, and the consequence is that the juice which enters the first of these evaporates as a clear yellow liquid; when it is dipped or "skipped" out, as it is termed, of the "teach," it has assumed the appearance of very dark treacle. The ordinary constituents of cane juice are—Water, 81 per cent; sugar, about 18; organic bodies, like gum, 0·6; and inorganic, like salts, about 0·4. This is only a rough general analysis, which takes no notice of the presence of any inverted sugar, and so far, therefore, it is incorrect, inasmuch as cane juice always contains a small quantity of this altered sugar ready formed, amounting generally to about 0·5 or 0·6 per cent of the whole amount of sugar, that is, in sound, ripe canes; in those which are rotten, or half rotten, the proportion is much higher. After the liquid has been boiled in the first of these evaporating pans, it has been found that there is sometimes as much as 10 per cent of this altered sugar for every 100 parts of real sugar, while in the last, the "teach," where it has received its final concentration, and attained the highest temperature, and been subjected for the longest time to all these mischievous influences which I have mentioned, the proportion of this altered sugar has risen to 22 or nearly 23 per cent. The mischief of this is, not only that you have destroyed so much of the sugar, but the presence of this altered sugar renders it extremely difficult, even if it does not absolutely prevent, the recovery of another equal portion of still unaltered cane sugar in a marketable form. The liquid containing a considerable proportion of the altered sugar has the consistency of treacle, and it is not easily deprived of so much of its water by evaporation as to leave the unaltered sugar in a state of a hot saturated solution, capable of crystallising or cooling. Even if crystallisation is actually obtained, the crystals are formed in a thick, adhesive, semi-fluid mass, from which you cannot separate them; consequently the mischief of converting a portion of your cane sugar into this altered sugar is not confined to the simple loss of the quantity so converted, the actual loss being nearly double; for one part of this altered sugar appears to practically prevent the crystallisation of an equal weight of cane sugar.* This is one great source of loss, but previous to this there was another. I have said nothing at present about the yield of juice by this method of pressure between rollers; but it is a very poor one indeed. Average canes of good quality contain about 90 per cent of juice, there being only about 10 per cent of actual woody matter; yet it is considered a very good yield to get out 60 per cent. If, therefore, you only get 60 per cent out of 90, you have left in the residue half as much as you have won. That would not answer in most manufacturing operations, and it is a very poor yield as compared with what is obtained in working beet-root. Only two-thirds of the sugar is got out of the cane in the form of juice, and when that is obtained the manufacturer immediately proceeds to waste a great portion. At a moderate computation, an acre will grow 30 tons of sugar-cane, and in those you will have 90 per cent of juice, containing, say, 18 per cent of sugar; working this out, I find that the sugar produced from an acre is about 4·86, or nearly five tons. Then, taking the 60 per cent yield of juice, and allowing very moderately for loss, the sugar actually won is only equal to two and a half tons, so that the quantity of sugar sent into the market is about one-half of that which is taken off the ground. As the concentrated juice is "skipped" out from the teach, it is transferred to round, shallow coolers, and allowed to stand until it is of the right consistency, when it is put into hogsheads, the bottoms of which are pierced with a number of holes, loosely

* This statement must not be taken as an expression of a fully-ascertained fact as regards the quantity.

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stopped with some convenient material, such as the stalk of a plantain leaf, and there it is allowed to remain for a considerable time, in a warm temperature, over a grated floor, until, in fact, the crystals of sugar are formed, surrounded by a cool saturated solution of sugar, containing also many impurities, being what is called syrup. This syrup is allowed to drain away gradually, leaving behind a mass of soft brown sugar, which is known in the market as raw sugar. The quality of this product so obtained varies greatly on different estates, with the amount of skill applied in the manufacture, the quality of the cane, &c. Sometimes it is very bad indeed, as you may see by a sample on the table, and the colour varies with the quality. There is one sample of nearly pure sugar which is really raw cane sugar; but it was not made in the mode I have described, the manufacturer having exercised some little skill and judgment, and brought into use some of the more modern appliances which science has devised.

I will next describe an important method of getting the juice out of the cane, by which a much larger yield is obtained, whilst the juice itself is much purer, containing a smaller proportion of the organic salts, which are the bodies which most assist fermentation, which, as you know, produces a serious loss of sugar. The process is known by the name of diffusion, and it will, I dare say, suggest to you the means by which the juice is won. It is carried on upon a large scale at the Aska Sugar Works, near Madras, and Mr. Minchin, the able and energetic manager, assures me that it really leaves little or nothing to be desired. The yield of juice, instead of being only 60 per cent, amounts to over 85, leaving only 5 out of 90 per cent instead of 30, as in the old process. This is a very considerable gain at once; but, in addition, the juice is much purer than that got out by means of rollers; it is therefore more easily worked, and a larger quantity of sugar of finer quality is obtained. And when you recollect that every ton of sugar lost represents a loss of about £25 to the manufacturer, you will see that it is a matter of primary importance to get every cwt. possible. The principle of the method is this. The canes are cut up by suitable machinery into thin diagonal slices. These are filled into a cylindrical iron vessel, about 6 or 7 ft. high, and from 4 ft. to 4ft. 6in. diameter, the size being merely a matter of convenience. Room is left for the addition of so much water as will keep the slices afloat, so that they are surrounded by water on all sides. The vessel is allowed to stand for fifteen or twenty minutes, while a second vessel of like capacity is filled with cane cuttings, but no water being added. By this time a considerable proportion of the sugar contained in the cells of the plant has passed out through the cell walls into the surrounding water by the process of diffusion, similar to that which I exhibited to you, the organic non-saccharine bodies, which are mostly colloids, remaining behind. But as you will, doubtless, have remarked, this process of diffusion must come to an end when the water surrounding the cells contains as much sugar as that in the inside, and, practically, the extreme limit is not quite reached. However, when the water in the first vessel has got considerably charged with sugar, it is passed into the second, which contains fresh cane cuttings filled with highly concentrated juice. Diffusion then begins in the second vessel, the sugar in the cane cells being undiluted passes out into the diluted liquid and increases the strength of the solution, and at the same time the first vessel has been filled up with fresh water, so that the sugar remaining in the cane cells in it may also diffuse out. The stronger solution in the second vessel is then passed on into a third diffuser, containing fresh cuttings, and sometimes into a fourth, which is about the limit to which the process can advantageously be carried; and from thence, being now sufficiently concentrated, it is drawn off and taken to the clarifiers, and thence to a vacuum pan, for I need hardly say that while such a scientific method of obtaining the juice is followed, they do not boil it in the open air. While this is going on, the second supply of water has been passed on to the second diffuser, and so on consecutively, until it is found that the water from the first vessel contains no more sugar, and when that vessel is disconnected from the series and emptied, the second becomes the first of the series, and so on in succession, a vessel of fresh cuttings being added at the end, when one is removed at the beginning. It is a somewhat complicated system to describe, but it is very simple in work, and is found to yield very good results.

In some of the colonies, both English and French, improved methods of manufacturing sugar from the cane are coming, though slowly, into use; and taking into consideration the weight of canes which can be grown to the acre, the richness and the purity of the juice of these canes, it seems hard to believe that the makers of sugar from the comparatively poor beet will be able to hold their own, when they no longer possess a monopoly of skill and science. These improved processes of manufacture I must leave undescribed, time only allowing me to sketch in outline one of the many methods in actual use.

I must now pass on to some chemical facts which will concern us in the manufacture of sugar from beet-root, which is a more complicated process than that I have described as applied to the juice of cane. I have treated of the cane sugar manufacture in this order simply to show you how very small an amount of chemical knowledge is necessarily brought to bear in the manufacture of sugar from cane. All this, and much more, is required in the case of the beet-root sugar manufacture.

In the first place I must show you that lime, which is an agent very largely employed in the manufacture of sugar from beet-root, is much more soluble in solutions of sugar than in water. I cannot very well exhibit this to you in quantitative fashion, for naturally quantitative experiments consume a good deal of time, but I can show you that lime is taken up very largely by a solution of sugar. In a solution of sugar, to which I will add some slaked lime, after filtering it, we shall find that a considerable portion of the lime has passed into solution. Lime is an alkaline body, *i.e.*, possessed of powers like those of potash or soda, having the power of neutralising acids very effectually indeed; it has also the property, when in solution, of preventing fermentation. Thus a solution of caustic lime will prevent a solution of sugar from fermenting. Here is the filtered solution of sugar into which I put the lime, and I shall be able to show you that it is alkaline. Here is a slip of paper impregnated with tincture of turmeric. It is, as you see, of a yellow colour, but in the presence of alkalies it becomes of a reddish brown. You see it turns brown on being dipped into our solution. Here, again, is a slip of paper reddened with litmus, which has the property of turning blue on the application of an alkali, and this also answers to the test. I do this that you may see how readily the presence of lime can be detected, because I want to show you by-and-by how completely we can remove lime from a solution of sugar after it has been added. In the manufacture of beet-root sugar, lime has to be added at one stage in considerable excess, and it has to be removed afterwards with tolerable completeness, and you thus see how we can detect its presence.

I must now show you another property of lime, viz., that of very readily absorbing carbonic acid gas. I have here a ready-made solution of lime in sugar, which I take because it happens to be a convenient form in which to employ the lime. I will now prepare a little carbonic acid gas, with which I will fill a long glass tube; then, pouring some of the solution of lime in sugar into this glass basin, I introduce the mouth of the tube into it, so as to allow a small portion of the solution to enter, and on closing the mouth of the tube with my finger and agitating it, you will find that the lime present absorbs the whole of the carbonic acid gas. The liquid, you see

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has turned quite milky, owing to the fact that the carbonic acid combining with the lime has converted it into carbonate, and the carbonate of lime is not soluble in sugar. You see at once, therefore, that there is a method of removing an excess of lime from a solution of sugar; and this process is all the better for this reason, that carbonic acid is so very weak an acid that it is not capable of inverting the sugar itself. So that, when you have a solution of sugar containing lime, you can remove the lime without fear of injuring the sugar, by passing carbonic acid gas into it until no more is absorbed. On opening the mouth of the tube under water, I find that I did not pass in quite enough sugar-lime to absorb the whole of the carbonic acid acid gas, but there is only a very small quantity left.

A reaction which illustrates the same thing in another way, though, perhaps, not quite so clearly, is by passing the gas into a solution of sugar-lime, which I will now do, putting some of the sugar-lime into a glass vessel, into which I insert the delivery-tube of the apparatus for evolving carbonic acid gas. You will observe that precipitation will not take place for a short time, and for a reason which is not thoroughly explained at present, but the fact, I believe, is that an intermediate compound is formed between lime and carbonate of lime. Carbonic acid can be passed into a solution of sugar containing lime, until nearly a third of the lime is really converted into carbonate, without any precipitation taking place, and then, almost of a sudden, the solution will become thick and opaque, and the lime will be deposited as insoluble carbonate.

I will now briefly describe the properties of animal charcoal, which is a body of considerable importance in sugar-making. Animal charcoal is prepared from bones, and bones, as you know, consist mainly of two parts, one being an animal part, a sort of gelatinous material, which is stiffened by the other, an earthy body, diffused throughout the mass. I have here a mutton bone, out of which I have taken the earthy material, and you observe that although it keeps its form, it is quite flexible and elastic, that is the animal part. When the animal part is destroyed, which can be done by exposing the bone to a high temperature in contact with the air, the animal matter is entirely burnt away, and there is left behind an extremely brittle material, the earthy phosphate of lime. The earthy material of bone consists essentially of phosphate of lime, which is left behind when the animal portion is entirely destroyed by oxidation at a high temperature. But instead of carrying the burning process to this stage, if we may simply expose a fresh bone to a high temperature without allowing the access of air, as is done by ordinary charcoal burners, the volatile constituents of the animal body will go off in the form of various gases, and a considerable portion of carbon will remain behind in the solid form. But of course the earthy matter also remains behind, and consequently we shall get such a mass as I have here—a bone which has been heated to redness for two hours, but without the access of air; the volatile constituents, the oxygen, the hydrogen, the nitrogen, and some of the carbon, have gone off, leaving behind a great part of the carbon dispersed over the surface of the particles of phosphate of lime. We have, therefore, in animal charcoal a quantity of very finely divided carbon spread over the surface of the phosphate of lime. Bones which have been treated in this way, and subsequently crushed into coarse grain, such as I have here, are largely employed by the manufacturers and refiners of sugar under the name of animal charcoal. I have here some of the animal charcoal from which the phosphate of lime has been removed by the action of acid; it is an exceedingly light powder, so much so that the bottle, on giving it a shake, appears full of it, and on removing the stopper it escapes almost like smoke. The action of the animal charcoal resides entirely in this carbon, the phosphate of lime with which it is usually conjoined having no other use than to render the material firm, hard, and heavier than the sugar solution, and consequently usable on a large scale.

The action of this animal charcoal, to which I wish particularly to direct your attention this evening, is the power which it possesses of absorbing from an aqueous solution certain bodies which are exceedingly prejudicial to the sugar maker, viz., the organic bodies, the colloids which get into the juice more or less in the process of manufacture. Again, as a sample of these colloid bodies, I will take dextrine, not because it is better than others, but because I can more readily prove to you its presence or absence. In this flask there is a solution of dextrine, which I will prove, as before, by its action in the presence of iodine. I will now pour it into this tube, which contains a quantity of finely granulated animal charcoal, and, by turning a cock at the bottom, will allow it to run through slowly. I cannot on the present occasion allow sufficient time for the action to be complete; but if it stood for some hours the absorption of the dextrine would be very complete; as it is, it will probably be only partial; still, on treating the solution which has run through with iodine, you will see that there is a very perceptible difference in the quantity remaining in solution, as evidenced by the intensity of the colour produced.

In my next lecture I shall treat of the manufacture of sugar from beet-root by one of the most approved methods. I see that I shall not be able to enter into the question of the different modes of extracting juice from the beet, and their relative advantages and disadvantages, but must confine myself to the process most largely in use, and from that pass on to the method of purification most usually employed. I will now add a little iodine to the solution which has run through the animal charcoal, and you see it is scarcely coloured, showing that the dextrine has been in great measure absorbed.

(To be continued).

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, January 18th, 1872.

Dr. Frankland, President, in the Chair.

As unfortunately both the Secretaries of the Society were absent through illness, Dr. Odling kindly acted in their place.

Messrs. Martineau, Page, Munroe, and Child were formally admitted members of the Society, and after the donations had been announced, the names of the following gentlemen were read for the first time:—Lüdwig Mond, Edward Packard, jun., John Ruffle, Frederick John Bassett, Edward Handfield Morton, and Ross Scott, M.A.

For the third time—Messrs. Julian Louis Vanderstraaten, John Millar Thompson, Charles W. Vincent, Robert Barton, David Watson, William Thompson, William Forster, Henry James Helm, Thomas W. Fletcher, George Thomas Glover, and Thomas Eltoft, who were then ballotted for and declared duly elected.

Dr. Odling exhibited several specimens of rare chemical substances which had been lent to him by Dr. Richter and Dr. Theodor Schuchardt, amongst which were two samples of metallic indium, the larger weighing 200 grms., also a specimen of the zinc blende of Freiburg in which this element was first discovered. After briefly recapitulating the method of extracting it, he remarked that it was very soft, even more so than lead; its specific gravity, however, was much less, being only 7·3 or 7·4. It was, moreover, the most fusible of all the metals that were capable of being freely exposed to the atmosphere without undergoing any great change, its melting-point being 176° and there-

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fore considerably lower than that of tin or cadmium. When freshly cut or scraped it was white or faintly yellowish in colour, but quickly acquired a bluish tinge from incipient oxidation. The metal itself is not very volatile, but the chloride volatilises at a low red heat. It had been known for some time that 37 or 38 parts of indium combined with 35·5 chlorine, but from comparatively recent determinations of its specific heat by Bunsen and others its equivalent was found to be 113·5, so that the chloride at present known must be the terchloride. Specimens of metallic beryllium closely resembling boron in appearance, beautifully crystallised beryllium sulphate, metallic zirconium in the graphitic state obtained from the alloy of aluminium and zirconium, also of vanadium, vanadic acid, lithium, rubidium alum, and metallic rubidium were exhibited.

The PRESIDENT said the thanks of the Society were due to Dr. Odling for giving them the opportunity of examining these specimens of rare substances; he himself, and, in all probability, the greater majority of the Fellows present, had never before seen such fine specimens of these rare metals and their compounds.

Mr. DAVID HOWARD then read a paper on "*Quinicine and Cinchonicine and their Salts.*" The author stated that further investigation had convinced him that the alkaloid from cinchona bark, which he had briefly described in the *Journal of the Chemical Society* in the early part of 1871, was identical with the quinicine of Pasteur. He had carefully examined and compared the quinicine and its salts, prepared both from quinine and from quinidine, and found them to be identical. It is not merely the action of heat which causes the transformation of these alkaloids into quinicine, for their salts were but slightly affected when heated with water in sealed tubes even to a considerably higher temperature than would effect their complete conversion under favourable circumstances. Most of the salts of quinicine crystallise with difficulty: the chloroplatinate, $C_{20}H_{24}N_2O_2,2HCl,PtCl_4$, the oxalate, $2(C_{20}H_{24}N_2O_2)C_2H_2O_4+9H_2O$, and the acid tartrate, however, are exceptions, being readily obtained in a state of purity. Cinchonicine and its salts, whether prepared from cinchonine or cinchonidine, are identical, and closely resemble those of quinicine in their properties. The alkaloid is soluble in ether, and its salts are generally somewhat more soluble than the corresponding quinicine compounds. The chloroplatinate, $C_{20}H_{24}N_2O,2HCl,PtCl_4$, the oxalate, $2(C_2H_{24}N_2O)C_2H_2O_4+7H_2O$, and the acid tartrate all crystallise well. The action on polarised light exerted by quinicine from whatever source it is obtained is 39° to the right for the yellow ray, the base being dissolved in spirit; for cinchonicine it is 48°. The author concluded by discussing the question of the identity of the resinoid quinoidin with these alkaloids.

The PRESIDENT said that he had listened with great interest to Mr. Howard's communication on these isomeric alkaloids. Their properties and those of their compounds which he had so carefully examined would form points of comparison for future workers on the cinchona alkaloids of the quinine and cinchonine series, and it would be of interest to the members if the author could give them any particulars about the nature of this isomerism.

Mr. HOWARD having answered that he was at present unprepared to offer an opinion on this subject, Dr. WRIGHT said that some experiments on which he was now engaged, although in a different series of the alkaloids, might, perhaps, tend to throw some light on this question. By the action of phosphoric acid on codeia, two bodies having the same percentage composition as codeia are formed. These differ from codeia especially in the following property: codeia is precipitated from its solution by carbonate of soda only after some time, whilst both the new compounds are immediately precipitated; the first, however, is amorphous and soluble in ether, whilst the second is insoluble. By the action of hydrochloric acid on codeia he had obtained a compound, $C_{36}H_{41}ClN_2O_5$, showing that the real formula for codeia was $C_{36}H_{42}N_2O_6$, being double that usually assigned to it. In the same way he had found that the first of the new compounds had double the formula of codeia, containing C_{72}, and the second double that again, so that the new substances were dicodeia and tetracodeia respectively. They were therefore not isomeric but polymeric with codeia. Perhaps the relation in the cinchona series might also be that of polymerism and not isomerism.

Mr. HOWARD observed that from the very different action which quinicine had upon polarised light when compared with quinine and quinidine, he should be inclined to believe that the change which had taken place was something more than a simple polymerisation, particularly as the saturating power was the same. What he considered especially interesting was that the action upon polarised light of the new isomer quinicine from either source was absolutely identical, notwithstanding that the quinine and quinidine from which it was derived possessed in one case a powerful lævo-rotary action, and in the other a dextro-rotary, and the same might be said of cinchonicine. It would also appear that the quinicine is present in the original bark, and is probably the first formed alkaloid, being subsequently converted into quinine and quinidine.

Dr. ODLING then announced that besides the Faraday lecture by Professor Canizzaro arrangements had been made for the delivery of three other lectures during the course of the session, namely, "On Hydrocarbons," by Dr. Schorlemmer, F.R.S.; "On the Manufacture of Chlorine," by Mr. Deacon; and "On the Manufacture of Iron and Steel," by Mr. Riley.

The meeting was then adjourned until Thursday, February 1st, when there will be a paper "On the Relations between the Atomic Theory and the Condensed Symbolic Expressions of Chemical Facts and Changes.—Dissected Formulæ," by Dr. Wright.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, January 9th, 1872.

E. W. BINNEY, F.R.S., F.G.S., President, in the Chair.

"*On the Influence of Gas and Water Pipes in Determining the Direction of a Discharge of Lightning.*" By HENRY WILDE, Esq.

Although the invention of the lightning conductor is one of the noblest applications of science to the wants of man, and its utility has been established in all parts of the world by the experience of more than a century, yet, a sufficient number of instances are recorded of damage done by lightning to buildings armed with conductors to produce, in the minds of some, an impression that the protective influence of lightning conductors is of but questionable value.

The destruction, by fire, of the beautiful church at Crumpsall during a thunderstorm on the morning of the 4th inst., has induced me to bring before the Society, with a view to their being known as widely as possible, some facts connected with the electric discharge which have guided me for some years in the recommendation of means by which disasters of this kind may be averted.

For the proper consideration of this subject it is necessary to make a distinction between the mechanical damage, which is the direct effect of the lightning stroke, and the damage caused indirectly by the firing of inflammable materials which happen to be in the line of discharge.

Instances of mechanical injury to buildings not provided with conductors are still sufficiently numerous to illustrate the teriffic force of the lightning stroke, and at the same time the ignorance and indifference which prevail in some quarters with respect to the means of averting such disasters; for wherever lofty buildings are

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furnished with conductors from the summit to the base, and thence into the earth, damage of the mechanical kind is now happily unknown.

Even in those cases, where lightning conductors have not extended continuously through the whole height of a building, or where the lower extremity of the conductor has, from any cause, terminated abruptly at the base of the building, the severity of the stroke has been greatly mitigated, the damage being limited, in many cases, to the loosening of a few stones or bricks.

The ever extending introduction of gas and water pipes into the interior of buildings armed with lightning conductors has, however, greatly altered the character of the protection which they formerly afforded, and the conviction has been long forced upon me that, while buildings so armed are effectually protected from injury of the mechanical kind, they are more subject to damage by fire.

The proximity of lightning conductors to gas and water mains, as an element of danger, has not yet, so far as I know, engaged the attention of electricians, and it was first brought under my notice at Oldham in 1861, by witnessing the effects of a lightning discharge from the end of a length of iron wire rope, which had been fixed near to the top of a tall factory chimney, for the purpose of supporting a long length of telegraph wire. The chimney was provided with a copper lightning conductor terminating in the ground in the usual manner. In close proximity to the conductor, and parellel with it, the wire rope descended, from near the top of the chimney, for a distance of 100 feet, and was finally secured to an iron bolt inserted in the chimney about 10 feet from the ground. During a thunderstorm which occurred soon after the telegraph wire was fixed, the lightning descended the wire rope, and instead of discharging itself upon the neighbouring lightning conductor, darted through the air for a distance of 16 feet to a gas meter in the cellar of an adjoining cotton warehouse, where it fused the lead pipe connections and ignited the gas. That the discharge had really passed between the end of the wire rope and the lead pipe connections was abundantly evident from the marks made on the chimney by the fusion and volatilisation of the end of the wire rope, and by the fusion of the lead pipe. As the accident occurred in the daytime, the fire was soon detected and promptly extinguished.

Another and equally instructive instance of the inductive influence of gas pipes in determining the direction of the lightning discharge occurred in the summer of 1863 at St. Paul's Church, Kersal Moor, during divine service. To the outside of the spire and tower of this church a copper lightning conductor was fixed, the lower extremity of which was extended under the soil for a distance of about 20 feet. The lightning descended this conductor, but instead of passing into the earth by the path provided for it, struck through the side of the tower to a small gas pipe fixed to the inner wall. The point at which the lightning left the conductor was about 5 feet above the level of the ground, and the thickness of the wall pierced was about 4 feet; but beyond the fracture of one of the outer stones of the wall, and the shattering of the plaster near the gas pipe, the building sustained no injury.

That the direction of the electric discharge had, in this case, been determined by the gas pipes which passed under the floor of the church was evident from the fact that the watches of several members of the congregation who were seated in the vicinity of the gas mains were so strongly magnetised as to be rendered unserviceable.

The church at Crumpsall is about a mile distant from that at Kersal Moor, and the ignition of gas by lightning, which undoubtedly caused its destruction, is not so distinctly traceable as it is in other cases which have come under my observation, because the evidences of the passage of the electric discharge have been obliterated by the fire. From information, however, communicated to me by the clerk in charge of the building, as to the arrangement of the gas pipes, the most probable course of the electric discharge was ultimately found.

The church is provided with a copper lightning conductor, which descends outside the spire and tower as far as the level of the roof. The conductor then enters a large iron down-spout, and from thence is carried into the same drain as that in which the spout discharges itself. Immediately under the roof of the nave, and against the wall, a line of iron gas pipe extended parellel with the horizontal lead gutter which conveyed the water from the roof to the iron spout in which the conductor was enclosed. This line of gas-piping, though not in use for some time previous to the fire, was in contact with the pipes connected with the meter in the vestry, where the fire originated, and was not more than three feet distant from the lead gutter on the roof. As no indications of the electric discharge having taken place through the masonry were found, as in the case of the church at Kersal Moor, it seems highly probable that the lightning left the conductor at the point where the latter entered the iron spout, and by traversing the space between the leaden gutter and the line of gas-piping in the roof, found a more easy path to the earth by the gas mains than was provided for it in the drain.

In my experiments on the electrical condition of the terrestrial globe* I have already directed attention to the powerful influence which lines of metal, extended in contact with moist ground, exercise in promoting the discharge of electric currents of comparatively low tension into the earth's substance, and also that the amount of the discharge from an electro-motor into the earth increases conjointly with the tension of the current and the length of the conductor extended in contact with the earth. It is not, therefore, surprising that atmospheric electricity, of a tension sufficient to strike through a stratum of air several hundred yards thick should find an easier path to the earth by leaping from a lightning conductor through a few feet of air or stone to a great system of gas and water mains, extending in large towns for miles, than by the short line of metal extended in the ground which forms the usual termination of a lightning conductor.

It deserves to be noticed that in the cases of lightning discharge which I have cited, the lightning conductors acted efficiently in protecting the buildings from damage of a mechanical nature—the trifling injury to the church tower at Kersal Moor being directly attributable to the presence of the gas pipe in proximity to the conductor. Nor would there have been any danger from fire by the ignition of the gas if all the pipes used in the interior of the buildings had been made of iron or brass instead of lead; for all the cases of the ignition of gas by lightning, which have come under my observation, have been brought about by the fusion of lead pipes in the line of discharge. The substitution of brass and iron, wherever lead is used in the construction of gas apparatus, would, however, be attended with great inconvenience and expense, and moreover, would not avert other dangers incident to the disruptive discharge from the conductor to the gas and water pipes within a building. I have therefore recommended that in all cases where lightning conductors are attached to buildings, fitted up with gas and water pipes, the lower extremity of the lightning conductor should be bound in good metallic contact with one or other of such pipes outside the building. By attending to this precaution the disruptive discharge between the lightning conductor and the gas and water pipes is prevented, and the fusible metal pipes in the interior of the building are placed out of the influence of the lightning discharge.

Objections have been raised by some corporations to the establishment of metallic connection between lightning conductors and gas mains, on the ground that damage might arise from ignition and explosion. These objections are most irrational, as gas will not ignite and

* *Philosophical Magazine*, August, 1868.

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explode unless mixed with atmospheric air, and the passage of lightning along continuous metallic conductors will not ignite gas even when mixed with air. Moreover, in every case of the ignition of gas by lightning, the discharge is actually transmitted along the mains, such objections notwithstanding. A grave responsibility therefore rests upon those, who, after introducing a source of danger into a building, raise obstacles to the adoption of measures for averting this danger.

Dr. JOULE remarked that, at twenty minutes past four, when the hail storm was at its height, the atmosphere was illuminated by a bright red light. This phenomenon disappeared when the fall of hail ceased.

NOTICES OF BOOKS.

Technical Arithmetic and Mensuration. By CHARLES W. MERRIFIELD, F.R.S., Principal of the Royal School of Naval Architecture and Marine Engineering, &c. London: Longmans and Co. 1872. 308 pp., 8vo.

THIS is one of the deservedly popular series of text-books of science published by Messrs. Longmans. Mr. Merrifield deals with his subject in a manner that cannot fail to be clear to the student. The finding of the cube root is much simplified, and a rule is given which one can easily remember. Another feature is the introduction of a chapter on mechanical work. No person who thoroughly studies that chapter is at all likely to entertain the fallacy of supposing that a machine can produce perpetual motion. The obtaining of a specific gravity, or rather the arithmetical work it involves, is well treated. The book concludes with an admirable chapter on the Laws of Guldinus applicable to lathe-work; and there is appended a series of examination papers actually set at various public examinations. It is the best arithmetic we have seen.

Principles of Chemical Philosophy. By JOSIAH P. COOKE, jun., Erving Professor of Chemistry and Mineralogy in Harvard College. Second Edition. Boston: John Allyn.

MR. COOKE presents his work with the prefactory recommendation that the elementary facts of chemistry should be observed by the student in the phenomena in which they appear, and not learnt *memoriter* from the text-book, a method that he, with us, deprecates as leading to a superficial knowledge of the science. But the book is worthy of study by the scientific inquirer as well as by the student; for the author advances some very carefully considered theories. Professor Cooke's position renders the book also valuable to the teacher, because the latter can place perfect faith in the suitability of the questions proposed for examination. We must commend the arrangement: theory is not too strictly adhered to, but is made to serve its true purpose, to become a mnemonical chain by which facts are linked into one coherent whole easily grasped by the mind. The clear exposition of the relation of the atoms to heat, light, and electricity especially deserves notice. It is a text-book of which even Harvard may justly be proud, and we cordially recommend it to our English students.

MISCELLANEOUS.

To Grow Large Crystals.—In order to grow large crystals of such substances as sugar, borax, alum, and the like, Professor Schulze recommends the use of gelatinous solutions, such as pectin and gelatin. The crystals separate, suspended in the mass, and go on growing uniformly on all sides. In this way, irregularities and distortions are avoided. The determination of the amount of gelatinous matter to be added must be the result of experiment. The chief advantage appears to be to make the liquid of such a specific gravity as will hold the crystals in suspension.—*Scientific American.*

Extemporaneous Ink.—The following recipe will give black ink of good colour and permanency:—Take of tannic and gallic acids each 20 grains, dissolve in 2 fluid ounces of water; take also of crystallised sulphate of iron and of the dried sulphate (*sulphas ferri exsiccatum*), of each 15 grains, and dissolve these separately in a similar quantity of water (best distilled); mix the two solutions, and add of mucilage (*mucilago gummi arabici*) 2½ fluid drachms, of oil of cloves 2 drops. Although this ink is by no means cheap, it is preferable to every other, and is a very fine black and quite permanent.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, December 26, 1871.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Very Perceptible Tension of Mercurial Vapours at a Low Temperature.—V. Regnault.—The celebrated *savant*, referring to M. Merget's essay on the volatilisation of mercury, calls the attention of the meeting to his discoveries on this subject as far back as 1838 and 1844 (*Annales de Physique*, 3rd series, vol. xi., 1844), and to what has been published by him in the *Memoires de l'Academie*, vol. xxxi., p. 506. It appears that even at −15° mercury was found by the author to be volatilised continuously.

Electrical Conductibility of Liquids when no Electrolysis takes place.—P. A. Favre.—Notwithstanding the great intrinsic merits of this exhaustive memoir, it is not suited for any useful abstraction, an observation also applicable to the following essay:—

Researches on the Condition of Metallic Salts while in Solution.—Dr. Berthelot.

Description of an Apparatus Suited for the Purpose o Estimating the Temperature at which Detonating Compounds become Changed and Explode.—L. Leygue and M. Champion.—From a tabulated form appended to this paper, and exhibiting some of the results of experiments made by the authors, we learn that fulminate of mercury becomes ignited and detonates at 200°; gun-cotton, at 220°; sporting powder, at 288°; gunpowder used for heavy ordnance, at 295°; the picrates of lead, iron, and mercury, all at 296°; nitro-glycerine, at from 256° to 257°; sulphur ignites in air at 246°; the powder (fulminate) contained in the caps of the Chassepot rifles, at 191°.

Analysis of the Amblygonite (Montebrasite) from Montebras.—F. Pisani.—After referring to the paper of Moissenet on this subject (see CHEMICAL NEWS, vol. xxiv., p. 97), the author states that, having observed the perfect mineralogical resemblance of Montebrasite with amblygonite, he has made an analysis of Montebrasite, the results of which, in 100 parts, are—Fluorine, 8·20; phosphoric acid, 46·15; alumina, 36·32; lithia, 8·10; soda, 2·58; oxide of manganese, 0·40; loss by ignition, 1·10; total, 102·85. Considering that these figures closely agree with those which Dr. Rammelsberg found for the amblygonite from Arnsdorff, Montebrasite cannot be viewed as a new mineral but as a real amblygonite.

Modification which Nitrous Acid Undergoes when in Contact with Arable Soil.—M. Chabrier.

Zeitschrift für Chemie von Beilstein, No. 14, 1871.

The following original papers and memoirs are contained in this number:—

Reciprocal Interchange of some Metalloids.—G. Gustavson.—After briefly referring to a former paper on this subject published by him some years ago, the author states that PCl_3 and B_2O_3 act upon each other in such a manner that all the chlorine of the chloride of phosphorus becomes chloride of boron. B_2O_3 and $POCl_3$ act in a similar manner—$B_2O_3 + 2POCl_3 = PBO_4 + PBOCl_6$; the mixture of B_2O_3 and $POCl_3$ is heated, for from eight to ten hours, to 150° in a sealed tube at the upper part of this tube crystals of $PBOCl_6$ are

sublimed, while at the bottom a whitish mass (PBO_4) is found; this latter body is, however, only a mixture, it appears, of—

$$2PBO_4 = P_2O_5 + B_2O_3,$$

but, after having been ignited, it becomes insoluble in water, and soluble in boiling alkaline solutions, but then salts of boric and phosphoric acids are formed. The compound $PBOCl_4$ can be dissociated by sublimation.

Amido-Camphoric Acid.—F. Wreden.—Amido-camphoric-acid-anhydride, $C_{10}H_{13}(NH_2)O_3$, is formed when bromo-camphoric-acid-anhydride, $C_{10}H_{13}BrO_3$, is heated to 150° along with aqueous NH_3. The amido-camphoric-acid-anhydride is a crystalline substance, fuses at 208°, begins, however, to sublime at 150°, is readily soluble in boiling alcohol, but only slightly soluble in cold alcohol, ether, and boiling water; by being boiled with weak potassa solution (10 per cent dry alkali), this substance is converted into amido-camphoric acid, while boiling with strong alkaline solutions converts it into oxy-anhydride of camphoric acid, $C_{10}H_{13}(HO)O_3$. Amido-camphoric acid—

$$C_{10}H_{13}(NH_2)O_4 + H_2O,$$

is also a crystalline body, difficultly soluble in ether and boiling water; it fuses at 160°, forming anhydride; it loses at 85° its water of crystallisation, and at about 100° it is converted into the anhydric acid; the author briefly describes some of the salts of this acid.

Basicity of Camphoric and Meso-Camphoric Acids.—F. Wreden.—After referring at some length to the opinions and researches of Weyl, Berthelot, and Gille, on the constitution and behaviour of camphoric acid with reducing agents, the author states that camphoric acid really appears to be a dicarbonic acid, which gives up readily a molecule of H_2O. The author next treats on a meso-camphoric acid, $C_{10}H_{14}O_4$, obtained by treating camphoric acid with HI (sp. gr. = 1·6) at a temperature of from 150° to 160° for two days, the mixture being heated in a sealed glass tube. The acid thus formed fuses at 113°, becomes oily when treated with alcohol and ether, and crystallises, without forming an anhydride (as ordinary camphoric acid does under the same condition), from its solution in strong sulphuric acid.

Action of β-Toluol-Sulpho-Acid-Chloride upon Acid-Amides.—Anna Wolkow.—This paper treats on the action of para-toluol-sulpho-acid-chloride upon benzamide, upon cinnamic-acid-amide, and upon acetamide. In the first instance, the result is the formation of benzo-nitrile, the reaction taking place according to the following formula:—

$$C_7H_7SO_2Cl + NH_2(C_7H_5O) = C_7H_7SO_2H + C_7H_5N + HCl.$$

In the second instance, cinnamic-acid-nitrile, hydrochloric acid, and β-toluol-sulpho-acid are formed. The action upon acetamide is quite analogous, but, instead of aceto-nitrile, a compound of that body and hydrochloric acid is formed.

New Amido-Acids.—Anna Wolkow.—This paper contains an account of researches made on benzoyl-para-nitro-toluol-sulpho-amide, $N(C_7H_6[NO_2]SO_2)(C_7H_5O)H$, a crystalline body, soluble in water; it fuses at 130°, and forms with several bases well-defined salts. Further, on benzoyl-para-naphthalin-sulpho-amide—

$$N(C_{10}H_7SO_2)(C_7H_5O)H,$$

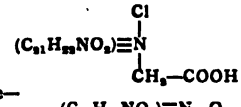
a crystalline body, insoluble in water, very difficultly soluble in alcohol and ether, soluble in acetic acid; it fuses at 194°, and forms with bases well-defined salts.

Fluid of the Cimbex Larvæ.—Dr. A. J. van Rossum.—The author communicates in this paper the results of his researches on a peculiar green-coloured fluid which the larvæ of the *Cimbex variabilis (Blattwespe)*, saw-fly, eject on being touched. This fluid, devoid of taste and smell, exhibits an alkaline reaction, and was found, upon thorough examination, to consist of a concentrated alkaline protein fluid, which has a great resemblance to albumen; there was only a trace of ash, and, as regards the green colour, it is very probably due to chlorophyll.

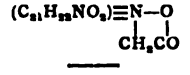
New Base from Strychnia.—Dr. P. Römer.—After first referring to the strychnin-oxethyl compounds discovered by Messel (*Ann. d. Chem. u. Pharm.*, clvii., part 1), the author states that he has studied the action of mono-chlor-acetic acid upon strychnia, both bodies being heated to 180° for several hours; after purifying, the author obtained a crystalline compound, which was found to combine with platinic chloride, $(C_{23}H_{24}N_2O_4.HCl)_2PtCl_4$. This new base is formed from strychnia according to the following formulæ:—

$$C_{21}H_{22}N_2O_2 : C_2H_3ClO_2 = C_{23}H_{24}N_2O_4Cl$$
$$C_{23}H_{23}N_2O_4Cl : NH_3 = NH_4Cl, C_{23}H_{24}N_2O_4$$

When the formula of strychnia is taken as $(C_{21}H_{22}NO_2)\equiv N$, the chlorine combination of the new base is—



and the new base—



Annalen der Chemie und Pharmacie, January, 1872.

The December number of this periodical has not come to hand yet; the present number contains the following original papers and essays:—

Contribution to our Knowledge of the Threefold Substituted Benzols.—M. Ascher.—This very lengthy and exhaustive essay is divided into the following sections:—Sulpho-terephthalic acid; bioxy-benzoic acid; diazo derivative of amido-toluol-sulpho adid; salicylic acid; 2-4-bioxybenzoic acid. This essay is elucidated by a series of complicated formulæ and diagrams illustrating the constitutional formulæ of the bodies treated of.

Formation of the Fatty Alcohols from their Initial Constituent Molecules (Anfangsgliedern).—E. Linnemann and V. V. Zotta.—Ninth instalment of this exhaustive monograph. This portion is divided into the following chapters:—Reduction of formic acid to form aldehyde and methylic alcohol; synthesis of normal propylic alcohol; reduction of propionic-acid-anhydride; reduction of propionic acid to propyl-aldehyde and propylic alcohol; the pure normal propyl compounds; behaviour of normal iodide of propyl; mono-bromated normal bromide of propyl; conversion of normal propylic alcohol into isopropylic alcohol; conversion of normal nitrite of propylamine into isopropylic alcohol; conversion of propylen-bromide or propylen-chloride into aceton or into isopropyl derivatives; action of nascent hydrogen upon propylen-bromide; action of hydriodic acid upon propylen-bromide; behaviour of propylen-bromide with water; behaviour of propylen-chloride with nascent hydrogen; behaviour of propylen-chloride with hydriodic acid; behaviour of propylen-chloride with water; comparative experiments made with methyl-brom-acetol and methyl-chlor-acetol; re-conversion of normal propylic alcohol from isopropylic alcohol.

Constitution of Æsculine.—H. Schiff.—The contents of this very exhaustive and highly valuable scientific memoir are not well suited for any useful abstraction by reason of the large number of complex formulæ it contains.

New Series of Aromatic Hydrocarbons.—T. Zincke.—Second paper on this subject. Benzyl-toluol is a colourless agreeably-smelling fluid, readily soluble in alcohol, ether, chloroform, and acetic acid; it is not solidified at −30°; sp. gr. of this fluid at 17·5° = 0·995; the boiling-point is about 279°; simplest formula, $C_{14}H_{14}$; structural formula, $C_6H_5—CH_2—C_6H_4—CH_3$. Benzoyl-benzoic acid—

$$C_{14}H_{10}O_3,$$

is the product of oxidation of benzyl-toluol; it is a solid crystalline substance, readily soluble in ether, alcohol, and glacial acetic acid; it fuses at 194°, and sublimes at a higher temperature. Benz-hydryl-benzoic acid, $C_{14}H_{12}O_2$, is somewhat soluble in hot water, readily so in alcohol and ether; it fuses at 164°, and becomes decomposed when heated to above 200°. Benzyl-benzoic acid, $C_{14}H_{12}O_2$, is a solid body, difficultly soluble in water, readily so in alcohol, ether, and chloroform; it fuses at 155°, and readily forms, like the foregoing acids, salts with baryta, lime, and oxide of silver. Methyl-benzo-phenon, $C_{14}H_{12}O$, a colourless oily fluid heavier than water, boils at between 307° and 312°, does not become congealed at a low temperature; treated with chromic acid, it yields benzoyl-benzoic acid, and with nitric acid it forms nitro products.

Continuation of Researches on Abietinic Acid.—Dr. R. Maly.

Journal für Praktische Chemie, No. 19, 1871.

This number contains the following original papers and memoirs:—

Decomposition of Albumen by Permanganate of Potassa.—H. Tappeiner.—The main gist of this paper is a refutation of the correctness of Béchamp's experiments (*Comptes Rendus*, lxx., 866) on the production of urea from albumen under the influence of the permanganate of potassa.

Decomposition of the Soluble Sulphurets by Water.—Dr. H. Kolbe.—The eminent *savant* first refers at length to the extensive thermo-chemical researches of Thomsen, and then describes a series of researches made with the view of elucidating, under varying conditions, the behaviour of the soluble sulphurets with water. The chief result of the author's researches is that when the soluble sulphurets become dissolved in water they undergo a partial decomposition, due to the fact that the metals of these sulphurets have an equally strong affinity for the oxygen of the water as for the sulphur, and, as a consequence thereof, these sulphurets (as mono-sulphurets) undergo a partial decomposition into sulphydrate of the metal and hydrated oxide of the metal when only a small quantity of water is present, but with a large quantity of water this decomposition will proceed further.

Reducing Action of the Hydrogen Absorbed by Palladium.—Dr. H. Kolbe.—The contents of this paper record a few experiments, from which it appears that the hydrogen absorbed by palladium has the property of converting nitro-benzol into aniline when the vapours of the former are passed along with hydrogen gas over spongy palladium; chlor-benzoyl is converted, under similar conditions, into benzoic-acid-aldehyde and benzyl-alcohol; with spongy platinum this does not occur.

Acetylen and Allylen.—E. Carstanjen.—Notwithstanding the intrinsic value of this exhaustive memoir, its contents are not suited for useful abstraction.

Les Mondes, January 11, 1872.

Effect of Severe Cold upon Cast-Iron.—H. Cock.—The author relates that the cast-iron framework of a 12-horse horizontal high-pressure steam-engine, employed at the printing-works of MM. Renou and Maulde (Paris), after having been exposed for some hours to a temperature of −15° during the night of December 8 to 9 last, suddenly snapped to pieces in three different places when the engine-driver attempted to start the engine very cautiously and at slow speed on the morning of December 9 last.

Description of a Very-Large-Sized Electrical Induction Apparatus.—Dr. Wahl.—Illustrated by several woodcuts.

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Bibliography.—Under this heading we notice the following:—"Annuaire pour l'An 1872, Publié par le Bureau des Longitudes." "Manuel Pratique et Elémentaire d'Analyse Chimique des Vins," par E. Robinet; this work is highly spoken of by the excellent editor of *Les Mondes*, and it is stated to contain a very perfect *resumé* of all that is scientifically known about wine and the methods of testing it. "Studi Sopra gli Strumenti Magnetici," par l'Abbé Braun, S.J.; this work, on the magnetical instruments required for making observations on magnetism, is here stated to be the most complete and precise ever published; the author has charge of the instruments of the Observatory of the Collegium Romanum at Rome.

Le Moniteur Scientifique Quesneville, Nos. 359 and 360 (one number), December 1 and 15, 1871.

This number does not contain any original papers relating to chemistry, but we call attention to a paper on a—

New Kind of Diving-Bell.—A. Guiot.—Illustrated with woodcuts.

Bulletin Mensuel de la Société Chimique de Paris, April, May, and June (one number), 1871.

This number, just published, contains only the following original essay:—

Ammoniacal Platinum Bases.—P. T. Cleve.—This lengthy essay, chiefly a series of formulæ, is divided into the following sections:—Introduction, containing a general review of this subject; combinations of hydroxyl-sulpho-platino-diamine; bromo-sulpho-platino-diamine; combinations of aceto-hydroxylo-platino-diamine; action of bromine on the basic nitrate of diplatino-diamine.

La Revue des Scientifique de la France et de l'Etranger, December 23, 1871.

This number does not contain any original papers relating to chemistry, but we call attention to a very important memoir:—

On Free Universitary (Higher) Instruction.—Dr. P. Lorain.—This paper contains a valuable and excellent *resumé* on the labours of those who, in 1870, by order of the then French government, visited various civilised countries of Europe and America to inquire into the subject of universitary instruction and education.

December 30, 1871.

This number does not contain any original papers relating to chemistry, but we meet here with a continuation of the paper just alluded to, under the title—

The Catholic Party and Higher Instruction.—P. Lorain.

The American Journal of Science and Arts, December, 1871.

This number contains no original papers on chemistry, but as usual we meet here with several memoirs relating to geology, astronomy, botany, physical geography, and zoology.

NOTES AND QUERIES.

Canadol.—Will any of your readers say what canadol is composed of; where is it made in quantity; what is the number of patent if it is patented?—R. F.

Phenyl-Citramic Acid.—(Reply to S. E. P.)—You are right; phenyl-citramic acid has only one atom of N to eleven of H. The French edition from which the English translation was made has the same error.—T. S.

Stannate of Soda.—Can any of the readers of "Notes and Queries" inform me on the following points:—Is there an active demand for stannate of soda? In what form is it usually sold—crystalline, liquid, or amorphous? What is its present value per unit of tin?—C.

The Oxidising Power of Solutions of Permanganate of Potash.—Ammonia is not converted into *nitrate* of potash, as stated through an unfortunate error, but into *nitrite* of potash. In other words, permanganate of potash solutions convert ammonia into *nitrous acid*.—HUGO TAMM.

MEETINGS FOR THE WEEK.

MONDAY, Jan. 29th.—Medical, 8.
—— London Institution, 4. Prof. Odling, F.R.S., on "Elementary Chemistry."
TUESDAY, 30th.—Royal Institution, 3. Dr. W. Rutherford, F.R.S.E., "On the Circulatory and Nervous Systems."
—— Civil Engineers, 8.
WEDNESDAY, 31st.—Society of Arts, 8.
THURSDAY, Feb. 1st.—Royal, 8.30.
—— Chemical, 8.
—— Royal Institution, 3. Prof. Odling, F.R.S., "On the Chemistry of Alkalies and Alkali Manufacture."
—— Royal Society Club, 6.
—— London Institution, 7.30. Reading and Discussion of a Paper by Mr. Hyde Clarke, "On the Necessity for a Minister of Commerce."
FRIDAY, 2nd.—Royal Institution, 9. Prof. Tyndall, F.R.S., "Remarks on the Identity of Light and Radiant Heat."
—— Geologists' Association, 7.30. Anniversary.
SATURDAY, 3rd.—Royal Institution, 3. Wm. B. Donne, "On the Theatre in Shakespeare's Time."

TO CORRESPONDENTS.

R. Gregson.—Wagner's "Chemical Technology;" an English edition is in the press.

J. Mayer.—Arrived too late for this issue.

M. A. G.—Your communication is unsuitable for our "Notes and Queries" column; it should be an advertisement.

NOTICE TO AMERICAN SUBSCRIBERS.

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$$C_7H_7SO_2Cl + NH_2(C_7H_5O) = C_7H_7SO_2H + C_7H_5N + HCl.$$

In the second instance, cinnamic-acid-nitrile, hydrochloric acid, and β-toluol-sulpho-acid are formed. The action upon acetamide is quite analogous, but, instead of aceto-nitrile, a compound of that body and hydrochloric acid is formed.

New Amido-Acids.—Anna Wolkow.—This paper contains an account of researches made on benzoyl-para-nitro-toluol-sulpho-amide, $N(C_7H_6[NO_2]SO_2)(C_7H_5O)H$, a crystalline body, soluble in water; it fuses at 130°, and forms with several bases well-defined salts. Further, on benzoyl-para-naphthalin-sulpho-amide—

$$N(C_{10}H_7SO_2)(C_7H_5O)H,$$

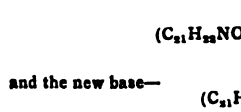
a crystalline body, insoluble in water, very difficultly soluble in alcohol and ether, soluble in acetic acid; it fuses at 194°, and forms with bases well-defined salts.

Fluid of the Cimbex Larvæ.—Dr. A. J. van Rossum.—The author communicates in this paper the results of his researches on a peculiar green-coloured fluid which the larvæ of the *Cimbex variabilis (Blattwespe)*, saw-fly, eject on being touched. This fluid, devoid of taste and smell, exhibits an alkaline reaction, and was found, upon thorough examination, to consist of a concentrated alkaline protein fluid, which has a great resemblance to albumen; there was only a trace of ash, and, as regards the green colour, it is very probably due to chlorophyll.

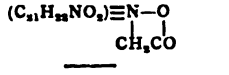
New Base from Strychnia.—Dr. P. Römer.—After first referring to the strychnin-oxethyl compounds discovered by Messel (*Ann. d. Chem. u. Pharm.*, clvii., part 1), the author states that he has studied the action of mono-chlor-acetic acid upon strychnia, both bodies being heated to 180° for several hours; after purifying, the author obtained a crystalline compound, which was found to combine with platinic chloride, $(C_{23}H_{24}N_2O_4.HCl)_2PtCl_4$. This new base is formed from strychnia according to the following formulæ:—

$$C_{21}H_{22}O_2N_2 : C_2H_2ClO_2 = C_{23}H_{24}N_2O_4Cl$$
$$C_{23}H_{24}N_2O_4Cl : NH_3 = NH_4Cl, C_{23}H_{24}N_2O_4$$

When the formula of strychnia is taken as $(C_{21}H_{22}NO_2)\equiv N$, the chlorine combination of the new base is—



and the new base—



Annalen der Chemie und Pharmacie, January, 1872.

The December number of this periodical has not come to hand yet; the present number contains the following original papers and essays:—

Contribution to our Knowledge of the Threefold Substituted Benzols.—M. Ascher.—This very lengthy and exhaustive essay is divided into the following sections:—Sulpho-terephthalic acid; bioxy-benzoic acid; diazo derivative of amido-toluol-sulpho adid; salicylic acid; 2-4-bioxybenzoic acid. This essay is elucidated by a series of complicated formulæ and diagrams illustrating the constitutional formulæ of the bodies treated of.

Formation of the Fatty Alcohols from their Initial Constituent Molecules (Anfangsgliedern).—E. Linnemann and V. V. Zotta.—Ninth instalment of this exhaustive monograph. This portion is divided into the following chapters:—Reduction of formic acid to form aldehyde and methylic alcohol; synthesis of normal propylic alcohol; reduction of propionic-acid-anhydride; reduction of propionic acid to propyl-aldehyde and propylic alcohol; the pure normal propyl compounds; behaviour of normal iodide of propyl; mono-bromated normal bromide of propyl; conversion of normal propylic alcohol into isopropylic alcohol; conversion of normal nitrite of propylamine into isopropylic alcohol; conversion of propylen-bromide or propylen-chloride into aceton or into isopropyl derivatives; action of nascent hydrogen upon propylen-bromide; action of hydriodic acid upon propylen-bromide; behaviour of propylen-bromide with water; behaviour of propylen-chloride with nascent hydrogen; behaviour of propylen-chloride with hydriodic acid; behaviour of propylen-chloride with water; comparative experiments made with methyl-brom-acetol and methyl-chlor-acetol; re-conversion of normal propylic alcohol from isopropylic alcohol.

Constitution of Æsculine.—H. Schiff.—The contents of this very exhaustive and highly valuable scientific memoir are not well suited for any useful abstraction by reason of the large number of complex formulæ it contains.

New Series of Aromatic Hydrocarbons.—T. Zincke.—Second paper on this subject. Benzyl-toluol is a colourless agreeably-smelling fluid, readily soluble in alcohol, ether, chloroform, and acetic acid; it is not solidified at −30°; sp. gr. of this fluid at 17·5° = 0·995; the boiling-point is about 279°; simplest formula, $C_{14}H_{14}$; structural formula, $C_6H_5—CH_2—C_6H_4—CH_3$. Benzoyl-benzoic acid—

$$C_{14}H_{10}O_3,$$

is the product of oxidation of benzyl-toluol; it is a solid crystalline substance, readily soluble in ether, alcohol, and glacial acetic acid; it fuses at 194°, and sublimes at a higher temperature. Benz-hydryl-benzoic acid, $C_{14}H_{12}O_2$, is somewhat soluble in hot water, readily so in alcohol and ether; it fuses at 164°, and becomes decomposed when heated to above 200°. Benzyl-benzoic acid, $C_{14}H_{12}O_2$, is a solid body, difficultly soluble in water, readily so in alcohol, ether, and chloroform; it fuses at 155°, and readily forms, like the foregoing acids, salts with baryta, lime, and oxide of silver. Methyl-benzo-phenon, $C_{14}H_{12}O$, a colourless oily fluid heavier than water, boils at between 307° and 312°, does not become congealed at a low temperature; treated with chromic acid, it yields benzoyl-benzoic acid, and with nitric acid it forms nitro products.

Continuation of Researches on Abietinic Acid.—Dr. R. Maly.

Journal für Praktische Chemie, No. 19, 1871.

This number contains the following original papers and memoirs:—

Decomposition of Albumen by Permanganate of Potassa.—H. Tappeiner.—The main gist of this paper is a refutation of the correctness of Béchamp's experiments (*Comptes Rendus*, lxx., 866) on the production of urea from albumen under the influence of the permanganate of potassa.

Decomposition of the Soluble Sulphurets by Water.—Dr. H. Kolbe.—The eminent *savant* first refers at length to the extensive thermo-chemical researches of Thomsen, and then describes a series of researches made with the view of elucidating, under varying conditions, the behaviour of the soluble sulphurets with water. The chief result of the author's researches is that when the soluble sulphurets become dissolved in water they undergo a partial decomposition, due to the fact that the metals of these sulphurets have an equally strong affinity for the oxygen of the water as for the sulphur, and, as a consequence thereof, these sulphurets (as mono-sulphurets) undergo a partial decomposition into sulphydrate of the metal and hydrated oxide of the metal when only a small quantity of water is present, but with a large quantity of water this decomposition will proceed further.

Reducing Action of the Hydrogen Absorbed by Palladium.—Dr. H. Kolbe.—The contents of this paper record a few experiments, from which it appears that the hydrogen absorbed by palladium has the property of converting nitro-benzol into aniline when the vapours of the former are passed along with hydrogen gas over spongy palladium; chlor-benzoyl is converted, under similar conditions, into benzoic-acid-aldehyde and benzyl-alcohol; with spongy platinum this does not occur.

Acetylen and Allylen.—E. Carstanjen.—Notwithstanding the intrinsic value of this exhaustive memoir, its contents are not suited for useful abstraction.

Les Mondes, January 11, 1872.

Effect of Severe Cold upon Cast-Iron.—H. Cock.—The author relates that the cast-iron framework of a 12-horse horizontal high-pressure steam-engine, employed at the printing-works of MM. Renou and Maulde (Paris), after having been exposed for some hours to a temperature of −15° during the night of December 8 to 9 last, suddenly snapped to pieces in three different places when the engine-driver attempted to start the engine very cautiously and at slow speed on the morning of December 9 last.

Description of a Very-Large-Sized Electrical Induction Apparatus.—Dr. Wahl.—Illustrated by several woodcuts.

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Bibliography.—Under this heading we notice the following:—"Annuaire pour l'An 1872, Publié par le Bureau des Longitudes." "Manuel Pratique et Elémentaire d'Analyse Chimique des Vins," par E. Robinet; this work is highly spoken of by the excellent editor of *Les Mondes*, and it is stated to contain a very perfect *resumé* of all that is scientifically known about wine and the methods of testing it. "Studi Sopra gli Strumenti Magnetici," par l'Abbé Braun, S.J.; this work, on the magnetical instruments required for making observations on magnetism, is here stated to be the most complete and precise ever published; the author has charge of the instruments of the Observatory of the Collegium Romanum at Rome.

Le Moniteur Scientifique Quesneville, Nos. 359 and 360 (one number), December 1 and 15, 1871.

This number does not contain any original papers relating to chemistry, but we call attention to a paper on a—

New Kind of Diving-Bell.—A. Guiot.—Illustrated with woodcuts.

Bulletin Mensuel de la Société Chimique de Paris, April, May, and June (one number), 1871.

This number, just published, contains only the following original essay:—

Ammoniacal Platinum Bases.—P. T. Cleve.—This lengthy essay, chiefly a series of formulæ, is divided into the following sections:—Introduction, containing a general review of this subject; combinations of hydroxyl-sulpho-platino-diamine; bromo-sulpho-platino-diamine; combinations of aceto-hydroxylo-platino-diamine; action of bromine on the basic nitrate of diplatino-diamine.

La Revue des Scientifique de la France et de l'Etranger, December 23, 1871.

This number does not contain any original papers relating to chemistry, but we call attention to a very important memoir:—

On Free Universitary (Higher) Instruction.—Dr. P. Lorain.—This paper contains a valuable and excellent *resumé* on the labours of those who, in 1870, by order of the then French government, visited various civilised countries of Europe and America to inquire into the subject of universitary instruction and education.

December 30, 1871.

This number does not contain any original papers relating to chemistry, but we meet here with a continuation of the paper just alluded to, under the title—

The Catholic Party and Higher Instruction.—P. Lorain.

The American Journal of Science and Arts, December, 1871.

This number contains no original papers on chemistry, but as usual we meet here with several memoirs relating to geology, astronomy, botany, physical geography, and zoology.

NOTES AND QUERIES.

Canadol.—Will any of your readers say what canadol is composed of; where is it made in quantity; what is the number of patent if it is patented?—R. F.

Phenyl-Citramic Acid.—(Reply to S. E. P.)—You are right; phenyl-citramic acid has only one atom of N to eleven of H. The French edition from which the English translation was made has the same error.—T. S.

Stannate of Soda.—Can any of the readers of "Notes and Queries" inform me on the following points:—Is there an active demand for stannate of soda? In what form is it usually sold—crystalline, liquid, or amorphous? What is its present value per unit of tin?—C.

The Oxidising Power of Solutions of Permanganate of Potash.—Ammonia is not converted into *nitrate* of potash, as stated through an unfortunate error, but into *nitrite* of potash. In other words, permanganate of potash solutions convert ammonia into *nitrous acid*.—HUGO TAMM.

MEETINGS FOR THE WEEK.

MONDAY, Jan. 29th.—Medical, 8.
— London Institution, 4. Prof. Odling, F.R.S., on "Elementary Chemistry."
TUESDAY, 30th.—Royal Institution, 3. Dr. W. Rutherford, F.R.S.E., "On the Circulatory and Nervous Systems."
— Civil Engineers, 8.
WEDNESDAY, 31st.—Society of Arts, 8.
THURSDAY, Feb. 1st.—Royal, 8.30.
— Chemical, 8.
— Royal Institution, 3. Prof. Odling, F.R.S., "On the Chemistry of Alkalies and Alkali Manufacture."
— Royal Society Club, 6.
— London Institution, 7.30. Reading and Discussion of a Paper by Mr. Hyde Clarke, "On the Necessity for a Minister of Commerce."
FRIDAY, 2nd.—Royal Institution, 9. Prof. Tyndall, F.R.S., "Remarks on the Identity of Light and Radiant Heat."
— Geologists' Association, 7.30. Anniversary.
SATURDAY, 3rd.—Royal Institution, 3. Wm. B. Donne, "On the Theatre in Shakespeare's Time."

TO CORRESPONDENTS.

R. Gregson.—Wagner's "Chemical Technology;" an English edition is in the press.
J. Mayer.—Arrived too late for this issue.
M. A. G.—Your communication is unsuitable for our "Notes and Queries" column; it should be an advertisement.

NOTICE TO AMERICAN SUBSCRIBERS.

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British Association for the Advancement of Science (Office, 22, Albemarle Street).—The NEXT ANNUAL MEETING of this Association will be held at BRIGHTON, commencing on WEDNESDAY, August 14th, 1872.

President Elect—WILLIAM B. CARPENTER, M.A., F.R.S. F.G.S., F.L.S.

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London International Exhibition of 1872.—TENDERS are invited for the privilege of TAKING and SELLING PHOTOGRAPHS. Conditions may be obtained on application to the Secretary, Upper Kensington Gore, on and after the 18th of January. Sealed tenders, marked "Photographs," must be sent in by noon on the 15th of February. Her Majesty's Commissioners do not bind themselves to accept the highest or any tender.—By order,

HENRY Y. D. SCOTT, Major-General, Secretary.

Geological Mineralogy, King's College, London.—PROFESSOR TENNANT, F.G.S., commenced the Second or PRACTICAL DIVISION of his LECTURES on Minerals and Rocks on Wednesday Morning, January 24th. The Lectures will be continued on each succeeding Friday and Wednesday at 9 a.m. Fee, £2 2s.

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THE CHEMICAL NEWS.

VOL. XXV. No. 636.

NOTES OF

DEMONSTRATIONS ON PHYSIOLOGICAL CHEMISTRY AT ST. GEORGE'S HOSPITAL.

By S. W. MOORE.

IX.

FOR the elaboration of blood food has to pass through certain processes in the intestinal canal; these are generalised under the term digestion. During the comminution which food undergoes in the mouth it is mixed with saliva, a viscid, colourless fluid secreted by the parotid and other glands of similar structure.

Fresh saliva is alkaline; it contains potash salts, phosphate of lime, sulphocyanogen, and an active principle (ptyaline); it has a sp. gr. of about 0·1008 (Wright); its solid residue is small. 100 parts contain—

	According to Berzelius.	According to Simon.
Water	992·9	991·225
Solids	7·1	8·775
	1000·0	1000·000

1000 parts of saliva are said to contain 2·9 parts of ptyaline. The active principle may be extracted from saliva by evaporating to dryness, washing with alcohol, and dissolving in water, in which it is soluble.

Saliva lubricates the throat and mouth, assists in comminuting the food, and dissolves soluble substances to render them capable of being tasted.

The pytaline acts in converting starchy matter to sugar in much the same way that the "diastase" of plants does, setting up an action which continues without additional ferment. The presence of sulphocyanogen in saliva may be tested by a per-salt of iron.

The pancreas secretes a fluid similar to saliva in its constitution and action, it contains an active principle identical with ptyaline, it also contains considerable albumin, it is supposed to be capable of assimilating fats, and has lately had attributed to it the power of dissolving albumin.

The gastric juice secreted by the follicles of the stomach is, perhaps, one of the most important fluids of the body. This secretion is a viscid, clear fluid, having a free acid reaction (prob. lactic), an active principle (pepsine), and salts, especially phosphates.

It has the following percentage composition in 1000 parts:—

Water	984·00
Organic matter	10·52
Soluble salts	5·02
Insoluble salts	0·46
	1000·00

This fluid is comparatively simple, and has a very definite action; by the aid of its pepsine albuminous matters are attacked and dissolved: this is readily demonstrated by putting into a mixture of pepsine and water with a little HCl any albuminous body, and subjecting the whole to a temperature of 45° C.; in the course of a few hours it will be converted into chyme.

Gastric juice is useful, no doubt, in a more extended sense than we attribute to it. Tuson has lately found that insoluble salts, as calomel, are attacked and dissolved by it, thus accounting for their ready assimilation; it must, however, act differently for various substances, and it is doubtful whether any fixed rule can be formed regarding them.

Pepsine, which is extensively used in debilitated states of the digestive organs, to assist them in dissolving food, may be obtained from the fresh stomach of any animal by macerating in water and precipitating with acetate of lead; H_2S passed through the suspended precipitate separates the lead, and leaves the pepsine in solution, which may be dried by evaporation. Messrs. Bullock and Co. are said to prepare it without lead.

Besides these secretions there are others of minor importance discharged from small glands at various parts of the intestinal canal, and also the bile, of this we shall treat separately.

The result of the action of saliva and gastric juice on food is to produce a pultaceous mass which is called chyme, certain portions of which have been converted into a modification of albumen termed peptone; this chyme then passes from the stomach to the duodenum, and there becomes further modified by the pancreatic juice and bile. On passing down the intestines it meets the villi, which are actively engaged in abstracting the nutritious portions to be conducted along vessels called lacteals, to a receptacle destined to receive this new fluid, or chyle; from this reservoir it passes upwards through a duct to the left subclavian vein, and there mingles with the blood about to return to the heart, from whence it is forced into the lungs, and, having undergone oxidisation, is converted into blood ready for the nutrition of the body.

The refuse from which the chyle has been drained is then cast off into the draught.

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By H. KOLBE.

NEW and improved conveniences for chemical laboratories deserve to be brought into general notice for imitation; and obeying this precept, I purpose to describe the ventilating arrangements by which the working-room of the new Leipzig laboratories are continually supplied with fresh air.

No building requires good ventilation in its apartments more than laboratories, when often thirty or more inexperienced young chemists experiment together in one room and load the air with vapours and foul-smelling gases. Even the skilful and experienced cannot always avoid thus vitiating the atmosphere of the workroom.

In the construction of the above-named laboratories great care was used to secure thorough ventilation.

Small steam-drafts, placed in the jambs of the windows, as first arranged by Hofmann in the Bonn laboratory, contribute somewhat to the purification and renewal of the air; but these do not exhaust sufficiently to render the air continually pure. Moreover, it is hardly possible in winter, with closed doors and windows, to have several of them in operation at the same time. The quantity of air, which finds entrance through the cracks of the windows and doors and through the porous outer walls, is less than that which the ten flues, leading from as many steam-jets, as in each workroom of this laboratory, can withdraw. The consequence is that the flues most heated and with the best draught have a very good upward air-current, while through the rest the current is downward. In this case it is of no avail to light gas-flames in the flues with contrary draughts. But the currents take their normal direction almost immediately, when by opening a window or by any other means the outside air is admitted in sufficient quantity.

This is effected in the new Leipzig laboratories in the most simple way and permanently by a broad flue,* which

* Translated by Elwyn Waller, E.M. From the *Journal für Praktische Chemie*.

* The area of this must correspond to the size of the room. In the room under consideration, with a capacity of 650 cubic metres, the flue 11 metres in height, has an area of 0·65 square metre (8 square feet).

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is built up in the cellar from the level of the surrounding yard or gardens and discharges in a corner of the room two feet below the ceiling. This draws up from the outside, through a wide opening made in the side, good pure air, and conducts it to the room above; in winter it is warmed by a coil of steam-pipes placed therein.

Through this continued influx of a large quantity of properly heated air, the atmosphere of the room attains a certain pressure, which suffices to cause a good current upward in all the fore-named ten flues of the steam-draught at the same time, if required, and warming them with gas-flames is generally unnecessary.

When the air-supply which these ten steam-draught flues, all working together, which is seldom the case, are able to carry away, is insufficient for the perfect ventilation of the room, there is provided, in the corner of every room, diametrically opposite to the supply flue, a second flue of similar dimensions closed below, into which (from the room) lead one or two broad side openings which may be closed partially or entirely by slides, and which will take as much air from the room as the other air-channel can supply. Of the two openings, one is just above the floor, the other is just below the ceiling, and these, according to circumstances and observations of what is needful to maintain the draught, are set more or less widely open.

To heat these exit-flues has been proved to be almost unnecessary, though undoubtedly this arrangement assists the matter much. The laboratory should possess a flat roof, provided with so-called wood-cement covering,* above which 150 chimneys altogether rise a distance of several feet, and with no other high building in the neighbourhood.

I have made the following test to prove the working of this ventilating arrangement. In one of the larger laboratories, while both the inlet and outlet air-flues as well as all the steam-jets were closed, I caused to be placed in several places about the room dishes containing hydrochloric acid and ammonia, near to one another, until the hall was filled with dense sal-ammoniac fumes, so that one could not see further than a metre in any direction. Thereupon the two ventilating apertures on opposite sides were thrown open. In the course of 15 minutes the air streaming through had already diluted the sal-ammoniac fumes to such an extent that one could see from one end of the hall to the other. After 15 minutes more the fumes were not more dense than ordinarily prevail in unventilated laboratories where several work together; and after 45 minutes in all, the atmosphere was entirely clear.

When one considers that such a stream of air pours through the laboratory throughout the day, and in summer through the night time also, he need not wonder that a good pure air always prevails there, so far as is in general possible in a chemical laboratory.

The establishment of this system of ventilation is extremely simple and easy, but it is by no means unimportant what the dimensions of the inlet and exit air-channels are. If these are built too narrow, the supply of air is not adequate to the needs, and, moreover—what is a still greater evil—at the same time there exists in the rooms to be ventilated an unendurable strong current of air. A broader air-channel, through which a larger current of air moves with less velocity, causes much less of an air-current in the room. The dimensions given above, and the relation of the breadth and the height of the air-supply channel to the size of the given room, are here fortunately so suitably chosen that, with full ventilation in the laboratory, in no place is there a disturbing current of air, and on all the desks the gas-flames burn quietly.

Heating.

For heating a large space, complicated in construction, simultaneously and uniformly, central heating should be most recommended. Of the three systems for this of air-, water-, or steam-heating, in the establishment of the laboratory of which I speak, I have given the preference to the latter, for the reason that in the laboratory the steam finds at the same time various other uses.

From the underground steam-boiler, about in the middle of the building, the steam goes to 30 rooms, which are to be heated with 46 heaters, and also, by means of iron pipes beneath the floor, heats the large lecture-room. The heaters are so arranged that one can at pleasure admit much or little steam to them, or shut them off altogether, without the steam-heating in general suffering interruption. The water condensed in the pipes and heater flows back to the steam-boiler, by which arrangement a great saving in fuel and also in water is effected. With these arrangements, when the weather is not too cold, if the boiler is heated up about 6 o'clock in the morning, all the laboratories are uniformly and comfortably warm by about 9 o'clock.

A second series of pipes, leading from the steam-boiler, serves to the application of steam to special chemical purposes, principally for obtaining distilled water, and at the same time for heating the copper drying-chambers.

These last are so constructed that the steam enveloping single cells enters below and also a few inches above the lower bottom of the drying chamber, and makes its exit on the opposite side above, and then through tin pipes is carried to the cooling-vessel for condensation.

With this disposition, the mechanically suspended impurities from the iron pipes are deposited in the drying-chambers, and the steam proceeding from them furnishes very pure distilled water.

The hot water condensed in the drying-chamber is from time to time drawn off at the spot which serves for cleaning the apparatus, &c.

The steam finds another application for heating the separate water-baths placed about in the laboratories. Instead of having numerous small water-baths for heating dishes containing solutions, &c., which need to be heated with charcoal, spirits, or gas, and in which the water may readily boil away without careful attention, for the majority of these cases a few larger water-baths serve, which are fed with steam from the steam-boilers. These consist of copper boxes 1 metre long and 0·6 metre wide, but low (at most 7 c.m. high), whose upper surface has several large and small round apertures for the reception of the evaporating dishes. These openings, moreover, can be closed by a sliding cover. Into the boxes, which stand in a niche provided with a perforated plate of slate, the niche having in front a glass sliding-window, the steam flows through one of the diagonally-placed copper pipes, provided with several fine holes, from which it is spread uniformly through the water-bath. The condensed water flows through a lead pipe provided for it into the general exit canal. These steam-baths have the advantage over the small water-baths that they may be put in operation at any moment. One needs only to open the cock to let the heating power of the steam operate. Among the applications of this steam-heating belong also, in fine, the ability of using the steam for various other purposes, *e.g.*, for rapid heating of water by directly conducting steam into it, for distilling, &c., if the necessary simple arrangements are made for it. For this nothing more than

* This kind of roofing wears extremely well, and possesses in general a number of advantages. The layer of sand and coarse gravel, from 5 to 7 c.m. thick, which forms the upper surface of the flat roof and gives it the appearance of a paved road, makes the roof thoroughly uninjurable by the strongest hailstorm, and protects the building from catching fire from burning pieces which may fall upon it, should a fire accidentally occur in the nighbourhood. Besides this it resists strong gales, violent winds. In December, 1869, when the roofs of all the neighbouring houses suffered more or less serious damage in the heavy storm at that time, the wood-cement roof of the laboratory remained quite undisturbed. The fine attics of buildings so roofed are, in contrast to those houses roofed with slate or with zinc, cool in summer, and protected to a certain degree in winter against cold, so that they afford habitable rooms which are easily warmed. An additional advantage of this roofing is that, with its simple foundation, its cost is only half as much as a roof the same size of English slate or of zinc. It is remarked as a curious circumstance, that in Leipzig, where wood-cement roofs are already moderately plentiful, one finds upon them small gardens with flower-beds and shady arbours.

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coupling-cocks, leading from the steam-pipes, and strong india-rubber hose upon them, is needed. In the laboratory of which I speak these cocks are in various places, especially in those laboratories devoted to the preparation of various compounds, and they come into general use.

The amount of steam which is used for what I have called special chemical purposes, is so small in comparison to the amount which serves for the heating of the rooms, that it scarcely noticeably increases the expense which the steam-heating entails, and this evidently makes a great saving in the laboratory. For the generation of steam for the purpose of obtaining distilled water, heating the drying chambers and water-baths, &c., during the summer, to avoid having to heat up the large steam-boiler, a small boiler placed near by is used, which works with a pressure of one atmosphere, and from which the steam is conducted through the same series of pipes to the most remote portion of the laboratory.

Sulphuretted Hydrogen Arrangement.

The most unpleasant guest in a chemical laboratory is the inevitable sulphuretted hydrogen. To get rid of the exceedingly irritating odour of this gas in the building of the laboratory, I thought out an unusual plan, to attain a suitable result, which would render it possible to banish this disagreeable odour from the rooms. The results have justified my expectations—indeed, more than justified them; and I desire here to describe this arrangement in the laboratory, which has proved so successful.

A gasometer, similar in design to the sulphuretted hydrogen gasometer, which Städeler has put up in the laboratory of the Zurich Polytechnic school, is placed in the cellar of the laboratory; this resembles in construction those of the illuminating gas companies (1·6 metre diameter and 2 metres high). This is filled from a neighbouring chamber, by means of a large generating vessel, which is so arranged that it can be taken out closed and emptied in the open air, and again be re-charged with sulphide of iron and hydrochloric acid. During the disengagement of the gas itself no smell of sulphuretted hydrogen is perceptible. Moreover, the water, which serves as a hydraulic valve to the gas-holder, is on the outside of the gasometer proper, covered with a film of oil, which prevents the exhalation of the sulphuretted hydrogen from the water saturated with it.

The gas collected in the gasometer is used in two rooms, one above the other, on the ground-floor and first story, which are in close connection with the 28 metre (100 Saxon feet) high chimney, which creates a draught for the fire under the steam-boiler, and is, moreover, arranged to draw off all the sulphuretted hydrogen which escapes as superfluous from the gas-pipes in both rooms. This is attained in the following manner:—

At the back wall of the room of which I speak, opposite the window, on a long narrow table, stands an arrangement with a number of small wooden closets of about 6 dcm. high, 2·5 dcm. broad, and 3 dcm. deep; each of these is provided with a glass door with two sashes, the lower of which may be raised by the wooden frame. These chambers run to a line in the back, and terminate in a slit reaching from top to bottom of 4 c.m. width. All the chambers connect, by these slits, with a horizontal canal, common to all, of the same height as the chambers, and 8 c.m. deep, also of wood, which leads through a hole in the wall, made for the purpose, into the chimney close by. The end piece of this canal, so far as it passes through the wall, is made of sheet-zinc.

The draught of the chimney is so strong, when one of the doors to the small chambers is opened a hand's breadth, it slams too with violence if let go. One can readily infer how thoroughly, with such a draught, all sulphuretted hydrogen which escapes into the chamber is drawn off. The leaden pipe placed above the chambers and attached to the wooden back wall, closeable by a cock, communicates with the sulphuretted hydrogen gasometer and conducts the gas into the chamber by a pipe connecting with it at right angles, which is bent downwards, and passing through the middle of the cover descends 5 c.m. into the chamber, so that over the end an india-rubber tube may be conveniently fitted. Each supply-pipe at the top of the chambers leading from the main pipe carries an ordinary gas-cock, and besides this also a second close behind it for closing the whole arrangement. This last is a cock only opened and closed by a key belonging to it. This second closure is intended to prevent the waste of the sulphuretted hydrogen, and is therefore so set, once for all, that even when the forward cock is wide open only a little gas can pass through.

The vessels containing solutions into which the sulphuretted hydrogen is to be introduced are placed in the chamber, a glass tube connected with the supply-pipe by rubber tubing inserted, and the cock opened. While the gas is on, the sash of the chamber should be somewhat open.

When such a vessel in one of the chambers breaks or is upset, in order to prevent its contents from running into the channel, or running over in front into the room, the bottom of the chamber is secured front and back with a wooden ledge, a finger's breadth in height, and moreover provided in the centre with a round hole through which the spilled liquid flows into a length of pipe, under the table, having a slight inclination, which discharges through a vertical extension into a capacious stationary jar.

Next to the eight small chambers there is a ninth larger one, with two glass doors, on an extension of the table. This is 5 dcm. wide, 5·5 dcm. deep 6 dcm. high, and communicates also in the back by a vertical slit with the draught-flue running to the chimney. This larger chamber is partly intended for the reception of larger vessels, which cannot conveniently he introduced into the small chambers, and partly for the application of sulphuretted hydrogen to such solutions as of arsenic acid, which during treatment with sulphuretted hydrogen must be heated. For this purpose, at the side of the table is a gas-cock, to which is attached by means of tubing a burner within the chamber itself. The roof of this chamber is covered on its under side with sheet-zinc to protect the wood from the heat radiated.

Both the rooms in which the sulphuretted hydrogen arrangements described are situated are so placed that one cannot enter them directly from the laboratories. The way leads from this, first through a passage communicating, and from there through the hall used for the preparation of compounds. Further precaution is taken that the solutions freshly impregnated with the gas shall be filtered from their precipitates in the sulphuretted hydrogen room itself.

In order to get rid of the little sulphuretted hydrogen which escapes thus into the air of the room, there is an opening in the wall leading directly into the large chimney, which may be closed by a sliding plate. With a strong draught in the latter it suffices to open the aperture for a few minutes in order to purify the air of the small room thoroughly and replace it by fresh air.

ASSAY FOR GOLD AND SILVER.

By T. M. BLOSSOM, E.M.,
Assistant in Charge of the Assay Laboratory of the School of Mines, Columbia College.

(Concluded from p. 39.)

2. *Gold Coin and Bullion.*

THE assay of gold coin and bullion comprises two determinations, (*a*.) of copper or base metal, and (*b*.) of gold. The difference between the sum of these two and the total weight of bullion represents the amount of silver.

(*a*). Base metal: Cupellation.

If the alloy contain no more than 20-1000ths of copper, weigh out 0·500 grms. and cupel with half a sheet of lead.

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If it contain more than 20-100oths of copper, cupel 0·250 grms. of the alloy with a whole sheet of lead.

If a large amount of silver be present, couple 0·500 grms. with a whole sheet of lead.

The copper is scorified and carried into the cupel by the litharge, leaving a button of the gold and the silver, if there be any, contained in the alloy.

A check-assay is made with every set of assays. We employ for this purpose a proof-alloy containing 850 parts gold, 12 parts copper, and the rest silver. This ought to lose by cupellation just the 12 parts copper. It may lose more or less, and, according to the difference one way or other, we correct the regular assays which have been made under the same conditions. Suppose the check-assay yielded 11·8-100oths copper; 0·2-100oth has been retained, and the proportion of copper obtained in each of the regular assays must be increased by this amount. If the check-assay had yielded 12·2-100oths as the proportion of copper, it would be known that 0·2-100oth of silver had been lost, and the proportion of copper obtained in each of the regular assays would be diminished to this extent.

(*b*). Gold: Parting.

We take for this operation a certain weight of the alloy, 0·5 grm., and add to it such an amount of silver as, when added to that already present, will make the silver twice the amount of gold. The reasons for doing this have been stated already under the head of "Inquartation and Parting" in the assay of ores. If there is no silver in the alloy, the approximate amount of gold is given by the assay for base metal, whence the quantity of silver to be added. If the alloy contain silver, the assayer must rely upon his own judgment, guided, perhaps, by the touchstone, or by comparative slips of known fineness, unless he choose to take the trouble of parting the button obtained in the previous operation. Wrap the alloy (0·5 grm.) and silver in a sheet of lead, and cupel it.

If the alloy be above 950 fine, add say 0·005 grm. of rolled copper, to toughen the cornet. This addition should also be made in the fine gold proof.

The button obtained from cupellation is hammered on the anvil to flatten it somewhat. Three blows with a light hammer will suffice; the first simply to flatten, and the two others directed in such a way as to give the flat button an elongated form. It is then heated to redness in a clay annealing cup placed in the muffle, and afterwards is passed between the rolls of a small flatting-mill. When rolled sufficiently thin the ribbon is again annealed and wound into a cornet or spiral round a small glass rod. The button must be reduced to a suitable thickness on the one hand in order that the silver may be dissolved completely, and on the other that the gold cornet may remain whole after the operation of parting.

Parting.—The cornet is next subjected to the action of nitric acid in a glass mattrass of about 3 ozs. capacity. Pure acid, absolutely free from chlorine, is added at different intervals, and heat applied. Acid of two different degrees of strength is employed. The first has a sp. gr. 1·16 (21° Baumé); the second, a gravity 1·26 (32° Baumé). The reason is that if very strong acid were used at first, in the presence of considerable silver, the action would be too brisk, and might break up the cornet; and, on the other hand, the weaker acid would not remove the last traces of silver, which are difficult to separate. Enough acid (about one half-ounce) must be added in each case to cover the cornet completely. First, pour on acid of 1·16 sp. gr., and heat for ten minutes; replace this by acid of 1·26 sp. gr., and boil ten minutes; decant, and make a second boiling with acid of the same strength (1·26) for another ten minutes. A gentle boiling is intended, and not a tumbling about of the cornet. It is customary, indeed, to add sometimes a small piece of *thoroughly carbonised* charcoal, to prevent bumping of the cornet. Finally, the cornet is washed with distilled water, the flask s filled completely with water, a porcelain crucible or capsule is placed over the neck, and the whole is inverted. The cornet falls gently through the water into the capsule, the flask is removed, the water decanted, and the cornet dried, and annealed in the muffle. The weight of this cornet gives of course the total amount of gold in the sample assayed. The gold, copper, and silver are reported in thousandths, as in the assay of silver bullion.

We make in this determination, as in the previous one, a check-assay with each set of coin or bullion assays. The metal used is pure gold; and as the standard fineness of the gold coin of the United States is 900-100oths pure gold, the test-assay is made upon 900-100oths of a ½ grm., when United States coin is being assayed. The regular assays are corrected, as in the previous determination of copper, according to the indications of the test assay.

3. *Native Metal and Alloys.*

Rough metal in scales, &c., left on the sieve during pulverisation of ores.

The assay of the above material consists ordinarily of scorification, cupellation, and parting. The quantity of test-lead for scorification would vary in every case; but an appreciation of what has been said already concerning scorification will enable the assayer to judge of the proper quantity.—*American Chemist.*

ON THE MANUFACTURE AND REFINING OF SUGAR.*

By C. HAUGHTON GILL.

(Continued from p. 42).

LECTURE III.

I SHALL enter to-night upon the consideration of a process of manufacturing sugar from beet-root. I say a process, because there is more than one employed, and I shall not have time to describe them all. I shall therefore describe the process which, up to a recent time, at any rate, has been most generally employed, and which is, on the whole, the most simplest to understand. I shall not enter into the nature and culture of the beet-root, for it has been very ably discussed before in this room, and I can add nothing whatever to what has been said on the subject. The roots, however, I may say, require tolerably deep soil, and when grown under fair conditions, yield a crop of from 16 to 20 tons per acre. On the table are some specimens of roots grown in England, for which I am indebted to the kindness of one of the large London sugar refiners, Mr. James Duncan, of Lavenham. Some of these sugar-beets are rather larger than is considered good as a rule, for it is found that the larger beet-roots, generally speaking, contain juice much poorer in sugar than smaller ones. A root, to satisfy the requirements of a sugar-maker, should be of a regular shape, and free from rootlets. One of these I will cut in half, that you may get a general idea of the internal structure. You see that it is built up of a number of concentric rings, which, of course, are formed of a great number of small cells, each cell being filled with juice, that is to say, a watery solution of many bodies, including sugar. Of the non-saccharine constituents I may mention the phosphates, oxalates, citrates, malates, and chlorides of potassium, sodium, and calcium, some bodies resembling albumen, if not identical with it, and other gum-like, but little known, substances belonging to the class of colloids. Besides these, there is a small quantity of a material which rapidly changes colour when exposed to the air, and becomes black, just as a similar body does which is contained in the juice of walnut rinds. The percentage of sugar in these white beets varies greatly. I have analysed English grown roots with as much as 16 per cent of sugar, and others with not more than six. To what a degree of richness the roots may be brought

* The Cantor Lectures, delivered before the Society of Arts.

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is shown by the fact that some Austrian roots have been found to contain 18 or even 19 per cent of sugar in the juice. The object of the sugar maker when he has got the juice is, of course, to remove as many as possible of these impurities, and then to get out from the remaining liquid as much of the sugar as possible. I will point out, later, a reason why he is unable to extract the whole of the sugar from the juice that he wins.

The first operation performed in a beet-root manufactory is to wash the roots, which is done by a machine made for the purpose. This washing, which ought to be performed very carefully, being over, the roots are passed onwards, and are freed from the upper part, or crown, from which the leaves spring, and also from any worthless or decayed portions which may be noticed upon them. They then go to a machine, in which they are rasped up into a fine pulp. I have not a diagram showing the structure of this machine, but it practically consists of a drum, from 18 inches to 2 feet in diameter, and 2 feet long, the whole circumference of which is set with a number of saw blades, with teeth just sticking out of the circumference. This drum is caused to rotate with great rapidity, performing between 700 and 1000 revolutions in one minute. Near to it is a straight steel edge, and as the roots are passed into the hopper of the machine they fall down, and are rasped against these rotating saw teeth and, of course, as the teeth come round, they scrape out from the root a number of small strips, and gradually the roots are rasped up into a sort of pulp. Here is a specimen of the pulp, produced by an ordinary grater, which has somewhat changed colour, owing to the presence of the bodies which I just now mentioned. This pulp, which in practice is much wetter than this, because the manufacturer allows water to run into the machine while the roots are being torn up, is next folded up in a number of cloths made of coarse flannel; the pulp is put into the centre of the cloth, the edges of which are folded over, so that it is made into a kind of square cake. It is then put upon an iron plate, another plate upon the top, then another cake of pulp, and so on, till there are fifty, sixty, or seventy cakes piled one above the other. These packets are all put into a powerful hydraulic press, which is caused to exert a gradually increasing, but finally very great, pressure on the mass. Of the 95 or 96 per cent of juice which the roots contained 80 to 85 are obtained by this method. Where the process of diffusion is adopted 94 to 95 per cent is the practical yield of juice. The juice, as it is pressed out, runs in a vessel prepared to receive it, in the same way as it does from this mass which I squeeze with my hand. It is then somewhat dark-coloured, as it contains all the impurities I mentioned before, and has now to be clarified. If we simply boil it, as I have boiled some similar juice here, we do get a partial clarification, for the albuminous constituents coagulate in the same way as the white of an egg sets when it is heated, and form a kind of scum on the surface. The coagulation is by no means very perfect. But it is found that by the addition of some lime the process of coagulation, and consequent running together of many of the other constituents, is very much facilitated, owing to the formation of insoluble lime compounds. But this addition of lime prevents the coagulation of the albumen itself, which, therefore, remains in solution till it is partially destroyed by being boiled in the alkaline solution.

To illustrate this, I have put into a beaker a quantity of beet-root juice, and I will now add a small quantity of milk of lime, that is to say, ordinary quick-lime which has been slaked in water, and then stirred up to a thin cream. I will stir the two together, when the effect is, that the liquid immediately appears to grow whiter in colour, and there is now a quantity of small clots formed in the liquid. These will gradually collect together, and rise towards the surface, forming a kind of scum, and we find below a clear liquid of a moderate yellow colour. The juice will thus be clarified, or, as it is technically termed, defecated. This defecation is performed on a large scale in this way. The juice running from the presses is allowed to go into some large copper heaters, holding about 500 gallons each, and to each of these a quantity of lime is added which is equal to about 1 per cent of the weight of the roots from which the juice has been obtained. Before the lime is added, however, the juice is heated to a temperature of about 180° F. The lime being added, the coagulation commences, and then the heat is raised slowly by turning steam into the pocket of the pan. As the liquid approaches boiling-point, a scum arises in the way I have described, and as you will see take place here in a few minutes. I can show you the effect more easily by exhibiting a sample which Mr. Duncan has sent me of the juice after it has been clarified. Here is some of the original juice, which comes from the sugar factory at Lavenham, not only the first, but the only beet-root sugar manufactory in England; and here is some which has been subjected to the treatment I have described. It has been heated, the lime has been added, the scum has been allowed to rise, and the clear liquid has been drawn off. You will observe the great difference in the apparent purity of the product. I should add, in fairness, that this purification is even greater in appearance than it is in reality, for the quantity of impurities removed by this process of defecation is much smaller than the change in appearance would lead one to suppose. The next stage of the operation is this:—The juice defecated by the action of the lime contains still a considerable quantity of lime in solution, for though much of the lime which has been added has combined with the organic acids and other matters which were present in the juice, and has separated in the form of scum, still a great portion remains behind, and gives to the juice a distinct alkaline character, which, as I explained to you last time, is detectable by means of a turmeric or litmus test-paper. I have not explained exactly what I mean by alkaline character, but have only told you it is that character which lime, soda, and potash possess of neutralising acids and turning vegetable colours in the way I have shown. I pointed out, for instance, that an alkaline solution is capable of turning turmeric paper brown, and by applying this test to some of this defecated juice, you will see that it is distinctly alkaline in its character. That is due, at any rate for the most part, to the presence of an excess of lime dissolved in this weak solution of sugar. Before the manufacturer can advantageously treat the solution so as to obtain sugar crystals, he is compelled to remove a great part of this lime by some process or another; and that which on the whole is most economical and most usually applied is by causing the lime present in such a solution to unite with carbonic acid gas, which, as I showed you before, forms a compound which is insoluble or very slightly soluble in a sugar solution, and thus separates in the shape of a white powder.

I can show that, in this particular case, by passing some carbonic acid gas into this solution, which, however, should have been boiling hot, as the decomposition would have been much quicker. I dare say you can see, however, that the liquid has become cloudy, and this cloudiness is due to the fact that the carbonate of lime formed by the absorption of the carbonic acid by the lime held in solution is insoluble in the solution of sugar, although the lime itself is exceedingly soluble. This solution, after it has been well saturated with carbonic acid and boiled, will have lost, in a great measure, its alkaline character, but not entirely so; for this alkaline character is due not alone to the presence of lime, but also to the presence of some bodies, such as soda, which have been liberated from combination by the lime previously added, and they, being soluble, do not fall to the bottom. When this operation is performed on a large scale, the workman continues to pass gas into the hot solution until he finds that the precipitate which forms clots together pretty readily, and sinks rapidly to the bottom of the vessel. He takes this as an indication

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that the operation is practically complete, the settling of the precipitate marking the termination of the action, and showing that nearly all the lime has become combined with carbonic acid, so as to become insoluble. I will filter some of this solution—when you see it is pretty bright, and of a somewhat paler colour than it was before. This diminution of colour, which really takes place when the operation is performed carefully, is greater in proportion to the quantity of lime that was present before carbonation, and is due to the fact that the carbonate of lime, as it is formed and precipitates, combines in a loose sort of way with a certain quantity of the colouring matter present, and carries it down into the sediment. In fact, the carbonate of lime forms with the colouring matter a kind of "lake," in the same way as alumina forms the ordinary lakes used in painting, when it is precipitated in a solution containing a vegetable colouring matter. On proving this filtered solution with the turmeric paper, you see that the colour produced is much lighter, and by the continued saturation of the liquid with carbonic acid, this change would have been more marked. I must now show you another experiment. In this glass I will put merely a solution of lime in water, adding some more distilled water to make it weaker. I will now pass carbonic acid gas into that. You immediately see the action takes place; the lime combines with the carbonic acid, and forms carbonate of lime, in the same way as it does in the solution of sugar. But what I want you to observe in this experiment is this, that on continuing to pass carbonic acid into the lime-water, until it is present there in excess, the carbonate of lime which was first precipitated will be dissolved, that is to say, the excess of carbonic acid re-dissolves the carbonate of lime first formed. It is very important to establish this point, but you must remember that this only takes place permanently in a cold liquid. Thus, if we heat the solution so obtained to the boiling-point, the carbonate of lime which has been dissolved owing to the excess of carbonic acid will be re-precipitated again. It is necessary to remember this, in order to understand why, when in a sugar factory they pass carbonic acid gas in to precipitate the lime held in solution by the gas, and, when the action is apparently complete, they are obliged to boil the liquid pretty vigorously for some time, for if they did not do so a quantity of the carbonate of lime which had been first precipitated would remain in solution, being re-dissolved by the excess of carbonic acid, and, what is worse, at the time the carbonate of lime is dissolved there is also dissolved the organic matter which that carbonate of lime previously carried down with it. You see, no doubt, this solution is already becoming clear again, the carbonate of lime being dissolved by the excess of carbonic acid; but upon boiling the clear liquid, you again see, as it gets hot, the excess of carbonic acid present is given off in bubbles, and in a few minutes the carbonate of lime dissolved will be re-precipitated, though not quite in the same way as before, but in a much more crystalline form, and it will adhere much more to the side of the glass, and therefore be less visible.

Supposing that this operation has actually been performed in the factory, that the juice has been first defecated, then saturated or carbonated with carbonic acid, that the excess of lime in the juice has been removed by carbonation, we get such a product as is contained in this bottle, which also comes from Mr. Duncan's factory. The juice has now, in a great measure, lost its alkaline character, having been deprived of a greater part of the dissolved lime by means of carbonic acid. There is, however, still some lime to be removed from the juice, and there are also contained a considerable number of those gummy and albuminous bodies which I before mentioned. These are partially removed, and at the same time a considerable portion of the colouring matter which gives this brown tint to the quid, by passing the juice through animal charcoal. This is done by taking the juice coming from the carbonating pan into an iron cistern, and there heating it nearly to boiling-point, and from there passing it into the top of tall vessels 15 or 16 feet in height, and 2½ to 3 feet in diameter, and filled with granulated animal charcoal. The juice finds its way through this charcoal gradually to the bottom, and runs out while a fresh supply is poured in at the top. As I showed you last week, the animal charcoal has a considerable power of absorbing bodies, such as dextrine, and if you give it a longer time and the liquid be hot, as in the case under consideration, the action is considerably increased and the liquid undergoes a very material purification. I have here some juice which has been defecated, carbonated, and also passed through the animal charcoal; and you will observe that the result is very much less coloured, the juice now being a very pale yellow tint, and a great portion of what small quantity of lime had been left in it by the carbonating process has been now removed, together with a material portion of the gummy matters. The carbonated juice might be sent up to the cisterns, in which it is held before it comes down to the animal charcoal, by means of common pumps, but it is not found advisable to do this in a beet-root sugar manufactory, because the inside of a pump is not very readily cleaned; and when beet-root juice is allowed to hang about, for even a comparatively short time, it begins to undergo a kind of fermentation; and when the juice contains, even for a very short time, any fermenting body, a considerable portion is converted into non-crystallisable sugar. Here is some beet-root juice which has been standing for some time in a bottle, and whereas in its natural state it flows freely, you see now it has become slimy and thick. Beet-root juice very readily passes into this state of fermentation, and, as it is difficult to use a pump without leaving behind in different parts of the apparatus a small quantity of the juice or of the pulp which is carried with it, and which soon gets into this sticky, slimy state, the operation of raising the juice to the iron cisterns is performed by an apparatus called a juice-lifter, of which I have here sketched a rough diagram. It consists of a wrought-iron cylinder, from the bottom of which proceeds a pipe leading to the cistern at the top of the building, whilst a branch from the same pipe communicates with the reservoir of juice to be lifted. The top of the cylinder has two openings, one communicating with the external air, and the other with a steam boiler. On opening the cock communicating with the air, and also the one communicating with the juice to be lifted, the iron cylinder is soon filled with the juice. These two cocks are then shut off, communication is made with the cistern to which it has to be lifted, and, at the same time, steam is allowed to enter from the steam boiler, and the pressure of the steam soon forces the whole of the juice in the cylinder into the cistern above. This apparatus, therefore, has the double advantage that none of the juice is left behind, and at each operation the vessel is thoroughly cleansed and scalded out by the action of the steam.

(To be continued).

PROCEEDINGS OF SOCIETIES.

GLASGOW PHILOSOPHICAL SOCIETY.

(Chemical Section).

Monday, January 15th, 1872.

Dr. William Wallace, F.R.S.E., President, in the Chair.

Mr. James Mactear, read a paper entitled "*Notes on the Loss of Soda in Leblanc's Process.*"

The author first gave an outline of the process and of the reactions which occur in the various stages of the

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operation so far as they are known, and he favourably noticed, in passing, the results of the experimental investigations made by Mr. Gossage, of Widnes, and those of Mr. Kolb, the manager of Messrs. Kuhlman's alkali works. In addition to the general reactions there are many of a minor character, owing to impurities in the raw materials. Some of these impurities only occur in traces, but in several instances they affect the results. One instance was given by the author which is of a very interesting character: it is the fact of tribasic phosphate of soda occurring in the highly concentrated mother-liquors, from which it separates in fine ruby-coloured crystals, the colour of which is due to the presence of traces of a vanadium salt. The author dwelt at some length upon the proper method of taking samples of the materials used and the products obtained, and on the general mode in which the experiments should be conducted.

The sources of loss in the soda process were stated by the author in the following way:—

I. *Loss in the sulphate manufacture.*
   1. As undecomposed salt.
   2. As loss in the process.

II. *Loss in converting the sulphate.*
   1. As undecomposed sulphate.
   2. As sulphide, sulphite, hyposulphite, &c.
   3. Volatilised and lost mechanically.
   4. Lost in the water, partly as insoluble and partly as soluble compounds.
   5. By secondary decomposition, as in the exposure of the ball soda to air and moisture, and the formation of sulphites, &c., and in the tanks, by the water being too hot or the digestion too much prolonged, and the consequent formation of sulphide of sodium.
   6. By the presence of iron, and the formation of double sulphate of iron and sodium.

Under these divisions and sub-divisions the author treated the subject. He stated that the loss as undecomposed salt is, in most well-conducted works, never over 2½ per cent, while in many it is under 2 per cent and he considered it questionable if it would pay to reduce this loss much further, inasmuch as there is a danger of some sulphuric acid being driven off with the hydrochloric acid, and thus a large amount of it would be required for the decomposition of the remaining 2 per cent. The loss in the process of converting the common salt into sulphate had been found to vary from 1 per cent to 0·05 per cent, and it is certainly not more than 0·5 per cent on the average, if it is even so much. The loss, as undecomposed sulphate, in the process of converting to carbonate was found, in a prolonged series of testings, to be on the average 1·53 per cent of the crude sulphate, showing that 98·47 per cent was rendered available. This loss is set down by Wright, in his paper read before the Chemical Society, at 3·49 per cent, while Hargreaves makes it about 2 per cent. In the case of well made bell-soda the loss in the form of sulphide is comparatively small, but otherwise there is often a considerable quantity of sulphide of sodium formed. The author finds it difficult to arrive at reliable results in respect of the loss as sulphide, sulphite, hyposulphite, &c., previous to the lixiviation, and he therefore classes it with the loss during lixiviation. There is but little, if any, loss by volatilisation, and in well-constructed furnaces, and such as are provided with carefully-worked check dampers, there need be but little material lost mechanically. The substance lost in the shape of flue dust occurs as common salt to a minimum amount, also as carbonate of soda, but chiefly as sulphate. In one instance where no check damper was used, the flue dust consisted of 60 per cent of sulphate of soda.

The chief loss in the soda process is that which occurs during the lixiviation of the ball-soda. This loss is in part represented by the insoluble and soluble compounds left in the waste. The former sometimes amounts to 3 or 4 per cent of the soda, and the amount is increased as the silica and alumina of the raw materials increase. It varied from 2·20 per cent to about 3 per cent of the soda represented by the original salt in the experiments made by the author. The actual loss from soluble salts left in the waste is usually equal to from 2 to 3 per cent on the original started with. Curiously enough, the oxidised alkali waste yields, on lixiviation, almost the whole of the soda contained in the waste. It occurs in the solution as sulphate. In one sample of this liquor there was as much as 920 grains of sulphate per gallon, and when the liquor was used to lixiviate a second quantity of the oxidised waste, the sulphate rose to 2700 grains per gallon. The loss by secondary decomposition is due, in a great measure, to the formation, in the first instance, of sulphite, hyposulphite, and sulphate of lime, which, in presence of carbonate of soda in solution, are converted into the corresponding soda salts. Under certain circumstances this action goes on very rapidly. The amount of sulphate formed in this way is seldom large, but the sulphite and hyposulphite together have been found to amount to 0·704 per cent of the original soda. The chief source of the loss from this secondary decomposition is in the formation of sulphide of sodium. This compound is almost entirely wanting in well made ball-soda, but it is readily formed from the decomposition of the sulphide of calcium in the tanks. The author's results, in respect of the loss by sulphide of sodium, give an average of 2·68 per cent on the original soda.

The author proceeded to summarise the results of manufacturing operations carried on over a series of years, choosing first an establishment on the Tyne where the production is considered good, and where the salt decomposed is about 26,000 tons per annum. The observations extended over a term of seven years, with the following results:—

100 parts yielded			
Available soda			84·54
Loss as neutral salts	7·26		
Loss in process	8·20		
			15·46
			100·00

In this instance the impurities, in the shape of chlorides, in the Tyne water interfered with the economy of the process to a very sensible extent, the loss in this way being from 5 to 6 cwts. as common salt per day.

An actual experiment with the work of one furnace being made—

100 parts yielded—			
Available soda			86·93
Loss as neutral salts	5·30		
,, in waste	6·96		
,, mechanically, &c.	0·81		
			13·07
			100·00

Taking the loss as neutral salts and in the waste together, there was totally lost in this experiment 7·77 per cent of the available soda.

Another actual experiment was most carefully performed, and under favourable circumstances, with the following results:—

100 parts yielded—			
Available soda			89·87
Loss as sulphide of sodium	2·81		
,, as other neutral salts	1·65		
		4·46	
,, in waste, insoluble	2·20		
,, ,, soluble ..	2·20		
		4·40	
,, in experiment		1·27	
			10·13
			100·00

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In an actual experiment embracing one years' work, there were the following results:—100 parts of common salt gave 86·318 parts of ash of 48 per cent strength:—

100 parts yielded—			
Available alkali			85·91
Loss as neutral salts—			
Sulphate of soda ..	5·22		
Common salt	2·90		
		8·12	
Loss in waste, &c. ..		5·97	
			14·09
			100·00

Leaving out of consideration the results obtained in the Tyne establishment, on account of the character of the water used, and those of the actual experiment referred to in the third table, inasmuch as it was an experiment performed on a small scale, the results are remarkably near each other, the average loss being as—

Neutral salts	7·09
Total loss	6·36
Loss in process	13·45

If the number of operations in the process, and the various complicated reactions which are involved, be considered, this loss can scarcely be deemed excessive, the actual total loss being under 7 per cent, the remainder of that being due to neutral salts existing in the product. These results, when compared with those of Wright, show a much smaller loss, about 6 per cent; but the fact that his sulphate contained 5·31 per cent of undecomposed salt is sufficient to show that the working was defective and the loss much higher than it should be. It would also seem as if the materials were very impure, as the insoluble soda is given by Wright as 5·44 per cent, an amount which the author considered exceptionally high. He also considered that there was room for improvement in the process, especially in the lixiviating operation, where the loss in sulphide takes place. A modified system of tanks and a good method of testing the liquors are the best means of checking the formation of this compound. Hargreaves gives six instances in which the loss varies between 10·72 and 20·65 per cent, the average being 16·49 per cent. Against this average the author gave from his approximate production book a loss of 11·5 per cent.

A short discussion followed, and several questions were put to Mr. Mactear, to which he replied.

CORRESPONDENCE.

THE FOREIGN DEGREE TRADE.

To the Editor of the Chemical News.

SIR,—The publication of the subjoined correspondence may possibly do something towards stopping the disgraceful traffic in academical degrees, to be granted *in absentia*, of which those who have really worked for the honours that have been awarded to them have so much cause to complain.—I am, &c.,

E. D. H.

An advertisement having been extensively published offering degrees *in absentia* upon application to "Medicus," 46, King Street, Jersey, I requested a friend to send the following letter:—

"Dear Sir,—Observing that you generously offer instructions for proceeding to degrees in foreign universities *in absentia*, I should esteem it a favour if you would let me know from what university a degree (not medical, nor clerical) could be obtained, and what would be about the *cost*.—Yours faithfully, ——; Sept. 26, 1871."

This business-like enquiry elicited the following equally business-like reply:—

"Dear Sir,—I shall be most happy to give you the benefit of my influence and assistance in obtaining for you a learned degree: as you, however, do not inform me your profession or occupation, I cannot very well judge what degree is most suitable. The degree would be granted by the American University of Philadelphia, one of the leading colleges in the United States. I undertake all the formalities at my own risk and expense; you would obtain the diploma *in absentia*, and without trouble or removing yourself. I could influence you one of the following degrees:—

Ph.D—Doctor of Physiology.
Ph.D.—Doctor of Philosophie (*sic*).
M.A.—Master of Arts.
B.A.—Bachelor of Arts.
Mus. D.—Doctor of Music.
D.C.L.—Bachelor (*sic*) of Civil Law.
LL.D.—Doctor of Laws.
Litt. Hum. D.—Litteræ Humaniores Doctor.

Therefore you may elect what you like best and let me know. The fees of the faculty, including the granting of degree, the cost of diploma, the signing by the professors, and passing collegical seal and registration dues amount exactly to £20, beyond which nothing is to be paid.—Waiting your reply at your earliest convenience, I remain, dear Sir, yours faithfully, P. F. A. V——.; Sept. 29."

On receipt of this letter I at once put myself in communication with the Provost of the University of Pennsylvania, who favoured me with extracts from the statutes of the University relating to the granting of honorary degrees (the regulations are quite as stringent as those of Oxford and Cambridge), and with an extract from the Act of the State of Pennsylvania, making "the payment, or promise of payment," by any person for an academic degree, or the signing of a diploma conferring a degree, under such circumstances a misdemeanor punishable by a fine not exceeding 500 dollars and six months' imprisonment, or both, or either, at the discretion of the Court.

On the day following the receipt of the above from Dr. Stillé, our Jersey friend favoured us with the following:—

"Dear Sir,—Shall be glad to be informed which degree you prefer; there are several to be had as Doctor of Philosophy, Doctor of Music, Doctor of Sciences, Master of Art, Bachelor of Art, &c., &c., all of which I can obtain for you *in absentia*. Give me anyhow a reply, as I am making up a list of candidates which are desirous to be nominated before Christmas.—Yours faithfully, P. F. A. V——., LL.D.; 46, King Street, Jersey."

To this I, through my friend, replied thus:—

"Dear Sir,—I was so struck with the price of all degrees being similar, having been accustomed to estimate gold and brass at different rates per pound, that I decided to write to an American friend before taking any further steps. As I observe from your notes that you are neither an Englishman nor an American, you will excuse me for informing you that "who," not "which," is, as a rule, applied to *persons*.—Yours faithfully, ——."

Believing the University of Pennsylvania to be, as it certainly is, far above selling its honours, I sent a copy of the above correspondence to Dr. Stillé, congratulated him on the energy of his European representative, and asking him for an official repudiation of the Jersey LL.D. (*sic*), and I have just received from him the subjoined letter. He appears to have taken mine more seriously than I had intended.

"Provost's Room,
"University of Pennsylvania,
"Philadelphia, Dec. 29, 1871.

"Dear Sir,—I am greatly surprised to find by your letter of December 11th that, after all my efforts to

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enlighten you on the subject, you are still in the dark as to the position of this University towards the fraudulent traffic in academic degrees which is now carried on in England. Need I repeat to you that this University has not, as you suppose, any 'representative' in England, and that no respectable college or university in this country would ever employ agents anywhere to recommend candidates for degrees or receive fees under any pretext when those degrees are bestowed. The rules among decent people here on this subject are quite as strict as at Oxford or Cambridge; indeed, they are stricter, for, according to our statute law, any person signing a diploma which has been paid for is liable to fine and imprisonment, and, besides, the degree purporting to be conveyed is absolutely invalid. You have probably been misled by supposing that, according to the European practice, there can be here but one university in one city. But the only application of the doctrine of 'free trade' which we have here is in the matter of education. The freest competition is allowed; and hence we have not only here this University (which is one of the oldest and best known in America, having been founded by the great Dr. Franklin in 1750), but also 'The Philadelphia University of Medicine and Surgery' and 'The American University of Philadelphia.' You will see at once that these titles are colourable (as the lawyers would say) imitations of our own. You will, of course, now understand that we are in no way responsible for their fraudulent practices, and can only, with all honest people, condemn them. If Englishmen wish to receive honorary degrees from colleges or universities in this country of the slightest reputation you will, perhaps, permit me to say that they must pay no fees under any pretext for such honours, and above all must have nothing to do with people calling themselves agents for the sale of degrees. I shall be greatly obliged if you would give this note as wide a publicity as possible. If the facts were generally known, a part of my English correspondence, which is very disagreeable and very laborious, might be given up.—Very respectfully, C. J. STILLE, Provost Univ. Penn."

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 1, 1872.

This number contains the following original papers and memoirs:—

Presence of Pyrocatechin in Kino.—F. A. Flückiger.—After briefly referring to Dr. von Gorup-Besanez's discovery of pyrocatechin as met with in a living plant, and the opinion expressed by that *savant* respecting the probable origin of pyrocatechin in kino (see CHEMICAL NEWS, vol. xxiv., p. 300), the author relates at length a series of researches made with several different samples of kino (presented to him by Mr. D. Hanbury, F.R.S., of London, all these samples being of well authenticated origin), in all of which pyrocatechin is present, the same substance being also found in the Australian *Eucalyptus* gum. From these facts the author draws the conclusion that the pyrocatechin present in the substances alluded to is due to its presence in the living plants from which these materials are extracted.

Decomposition of Sulpho-Bromide of Phosphorus by Water and Alcohol.—A. Michaelis.—The author refers first to his former paper on this subject (see CHEMICAL NEWS, vol. xxiv., p. 217), and next states that the sulpho-bromide of phosphorus is decomposed by alcohol simply in the manner that the bromine is exchanged for ethoxyl, giving rise to the formation of mono-sulpho-phosphoric-acid-ethyl, $PS.(OC_2H_5)$, a body already prepared and described by Dr. Carius ("Beitrag zur Theorie der Mehrbasischen Säuren," von Dr. L. Carius, p. 29). By a quantitative experiment, made to ascertain the products of the decomposition of sulpho-bromide of phosphorus under the influence of water at 100° in a sealed tube, the author obtained—Free sulphur, 7·59 per cent; phosphorus, 2·81; phosphorous acid and sulphur, together, 71·99; sulphuretted hydrogen and phosphoric acid, together, 28·01.

Sulpho-Bromo-Chloride of Phosphorus.—A. Michaelis.—By a rather circuitous and complicated process, starting with mercaptan and chloride of phosphorus, the author obtained ethyl-sulpho-phosphoric-acid-chloride, $PCl_2.(SC_2H_5)$, a colourless fluid, boiling at from 172° to 175°; sp. gr. at 12° = 1·30; it is decomposed by water into hydrochloric and phosphorous acids and mercaptan. Along with this compound the author obtained sulpho-phosphorous-acid-ether, $P(SC_2H_5)_3$, a colourless disagreeably-smelling fluid, boiling with partial decomposition at between 240° and 280°; sp. gr. at 12° = 1·24; water gradually converts it into phosphorous acid and mercaptan. In order to prepare sulpho-bromo-chloride of phosphorus, the author treated 1 molecule of $PCl_2.(SC_2H_5)$ with 1 molecule of bromine; the result of this operation (attended with difficulties, and a tedious process of purifying) is the formation of the body already mentioned, a faintly yellow-coloured fluid, exhibiting a pungent aromatic odour, boiling at 159° with partial decomposition, not acted upon by water even at 100°, but decomposed by that fluid at 150° in a sealed tube. The formation of this compound may be elucidated by the following formula:—

$$PCl_2.(SC_2H_5)+Br_2=PCl_2.(SBr)+BrC_2H_5.$$

Bromo-Chloride of Phosphorus.—A. Michaelis.—In the first portion of this paper the author refers at some length to Dr. Wichelhaus's investigations on this subject (*Ann. d. Chem. u. Pharm.*, suppl. bd. 6, p. 277), and next states that bromo-chloride of phosphorus is a yellow-red coloured solid mass, which becomes dissociated into chloride of phosphorus and bromine at 35°, but below that temperature the body is immediately re-constituted; in contact with water and acids it is decomposed in the following manner:—

$$3PCl_2Br_2+3(OH_2)=2POCl_3+POBr_3+3ClH+3BrH.$$

Action of Penta-Chloride of Phosphorus upon Nitro-Naphthaline.—L. de Koninck and P. Marquart.—After observing that Dr. Oppenheim stated some years ago that the chlorides of phosphorus do not act upon the various nitro-derivatives, the authors record a series of experiments just made by them the result of which is that when PCl_5 is heated (this operation requires caution when larger quantities of the substances are experimented with, owing to the very violent reaction then ensuing) along with nitro-naphthaline there is formed chloride of naphthaline, according to the following formula:—$C_{10}H_7NO_2+PCl_5=C_{10}H_7Cl+POCl_3+NOCl$; the chloride of naphthaline resulting from this reaction is in every respect identical with the body obtained by Faust and Saame (see *Ann. d. Chem. u. Pharm.*, bd. clx., p. 68). The chloride boils at between 251° and 255°; sp. gr. at 15° = 1·2025. PCl_5 does not act upon the rhombic modification of dinitro-naphthaline; nitro-benzol boiled along with PCl_5 does not yield chloride of benzol.

Carbazol.—C. Graebe and C. Glaser.—The authors relate at length how, by the process of purification of crude anthracen, they discovered, under conditions to be afterwards communicated, the body (carbazol) $C_{12}H_9N$, a solid substance, which, notwithstanding that it contains N, exhibits the general characters of a hydrocarbon; it crystallises, is insoluble in water, but soluble by the aid of heat in ether, alcohol, and benzol; it fuses at 238°, boils at 338°, is not decomposed at red heat, nor affected at that temperature by the contact of zinc-dust and soda-lime. Carbazol is soluble without decomposition in strong sulphuric acid; it is not decomposed by fusing caustic potassa, neither by a boiling concentrated aqueous solution of that alkali, but oxidising substances attack carbazol violently. With chlorine and bromine, substitution compounds are formed; with picric acid it forms a beautifully red-coloured crystalline body, $C_{12}H_9N,C_6H_3(NO_2)_3OH$. When carbazol is heated for some hours in a sealed tube to from 200° to 230°, along with a mixture of ½ part of amorphous phosphorus and 4 parts of hydriodic acid (boiling-point, 127°), there is formed carbazoline, $C_{12}H_{13}N$, a solid substance, readily soluble in alcohol, ether, and benzol, fusing at 96°, boiling at 286°, and yielding, with acids, salts which are readily soluble in water.

Vapour Densities of some Organic Substances having a High Boiling-Point.—C. Graebe.—The author describes at length a series of experiments on vapour density estimation of the following substances:—Anthrachinon; vapour density found by experiment, 7·33; the formula, $C_{14}H_8O_2$, requires 7·20. Pyren, $C_{16}H_{10}$: found, 7·2; theory, 7·0. Acenaphten, $C_{12}H_{10}$; found, 5·35; theory, 5·33. Phthalic-acid-anhydride; found, 5·32; the formula—

$$C_6H_4{<}\begin{matrix}CO\\CO\end{matrix}$$

requires 5·12. Acridine; found, 6·10; theory, 5·85. Chrysen; experiments did not succeed; chrysen boils at a temperature very nearly the same as that at which sulphur boils.

Relations Existing between the Crystalline Form and the Composition of the Native Compounds of Tantalum and Niobium.—Dr. C. Rammelsberg.—The contents of this essay, full of a large number of complex formulæ, are not suited for abstraction.

Nonylic Acid from the Octyl-Alcohol of the Heracleum Oil.—A. Franchimont and Th. Zincke.—In the first portion of this paper the authors refer to their former researches on this subject (see CHEMICAL NEWS, vol. xxiv., p. 263), and next state that they have, by treating the octyl-alcohol so as to form a cyanide, and next saponifying that body with alcoholic potassa solution, obtained an acid containing 9 atoms of carbon, which acid, separated from its potassa salt, has been termed by them nonylic acid, a colourless, oily fluid, which becomes solid at below + 10°, and boils at from 253° to 254°; sp. gr. at 17° = 0·9065; it is very slightly soluble in water. In addition to the methylic and ethylic ethers which this acid forms, the authors describe the potassa, soda, ammonia, baryta, lime, copper, cadmium, zinc, and lead salts of

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this acid. The formula of the ethylic ether is $C_9H_{17}O(C_2H_5)O$; that of the baryta salt is $(C_9H_{17}O_9)_2Ba$.

Tri-Amido-Benzol.—H. Salkowski.—In the first portion of this paper, elucidated by a series of formulæ, the author enters into a series of theoretical discussions, and next describes at great length the mode of preparation of tri-amido-benzol quite free from any tri-amido-phenol. The former of these two bodies (formula, $C_6H_3(NH_2)_3$) is a solid, deep red, crystalline substance; it fuses at between 103° and 104°, boils at 300°, and is readily soluble in water, alcohol, and ether. The concentrated aqueous solution exhibits an alkaline reaction, and yields with chloride of iron solution a precipitate, at first deep violet-coloured, afterwards brownish coloured. Treated with concentrated sulphuric acid containing a trace of nitric acid, tri-amido-benzol yields a deep blue colouration, which disappears by the addition of water. Hydrochlorate of tri-amido-benzol, $C_6H_3(NH_2)_3,2HCl$, is a crystalline salt, as is also the sulphate.

Combinations of the Aldehydes with Phenols.—A. Baeyer.—This lengthy essay is divided into the following sections:—Oil of bitter almonds; aldehyde; furfurol.

There is added to this number, as appendix, a list containing the names and addresses of the Fellows of this society. Any change of address is requested to be immediately reported to the publisher of the *Berichte*, Herr Ferd. Dümmler, 86, Wilhelmstrasse, zu Berlin.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 226, October, 1871.

This number does not contain any original papers relating to chemistry.

Journal de Pharmacie et de Chimie, December, 1871.

This number contains the following original papers and memoirs:—

On a Urine Containing a Violet-Coloured Sediment.—C. Méhu.—After first referring to the pathological conditions of the system which can affect the composition of urine, and also to Dr. E. Schunck's researches ("On the Occurrence of Indigo in Urine," *London, Edinburgh, and Dublin Philosophical Magazine*, 4th series, 1867, vol. xiv., p. 288), the author relates at great length the researches made by him on a urine which was found to contain a violet-coloured sediment. This urine exhibited a very alkaline reaction, contained some albumen, had a fœtid odour (when fresh), and became spontaneously red-coloured by exposure to air. By further research the author was enabled to extract from the sediment a red-coloured matter, insoluble in water, soluble in ammonia, alcohol, and ether. A blue substance was also obtained, and found to be insoluble in water, and difficultly soluble in chloroform and ether; this substance dissolves in strong sulphuric acid; the solution has a great resemblance to that of indigo in the same solvent, and, like the latter substance, is decolourised by chlorine and nitrous acid vapour; this blue pigment was obtained from urine in the state of crystals from a boiling alcoholic solution.

Preparation of Crystallised Indigotine by means of Phenic Acid.—C. Méhu.—The author begins by making the observation that, in works on chemistry, indigotine is described as a body insoluble in water, alcohol, ether, fatty and essential oils, and dilute acids and alkalies; yet strong and boiling alcohol, and even somewhat more so methylic alcohol (not methylated spirit), dissolve enough indigotine to become blue-coloured, but, on cooling, the greater part of the dissolved substance is thrown down again. By experimenting with phenic acid, the author has found that this substance is an excellent solvent for indigotine, which may be extracted readily and in pure state from indigo, care being taken to wash this latter substance first with water, then with dilute hydrochloric acid, and next several times with boiling hot alcohol; in order to prevent the solidification of phenic acid on cooling (heat has to be applied to dissolve the indigotine), some camphor may be added to it. With 500 grms. of phenic acid, 2 grms. of indigotine may be readily obtained in one operation, and in very pure well-defined crystals. Indigotine is also soluble, to some extent, in phenic acid when cold, this solution exhibiting a very deep purple colour.

Some of the Inconveniences Arising from the Substitution of Soda for Potassa.—P. Carles.—Among the instances brought forward by the author we quote the following:—When iodide of potassium is made with potassa which contains soda there ensues, by the calcination, a considerable loss of iodine; moreover, iodide of sodium renders iodide of potassium deliquescent in the air. When potassa contains soda it is less suitable for use in Liebig's bulbs, because the carbonate of soda which is formed by the action of the carbonic acid takes up water, and thereby renders the alkaline ley turbid, and may even so thicken the liquid as to stop the passage of the gas altogether. As regards the silicates of potassa and soda, the author observes that, although their physical properties are very similar to each other, silicate of soda cannot, in all respects, be used as well as that of potassa.

Reports on the Manufacture of Benzol, Nitro-Benzol, Aniline, and Fuchsine.—Dr. Vigla.—The author gives in this paper an excellent abstract of the labours of the Conseil d'Hygiène Publique et de Salubrité de la Seine on the proper precautions to be observed in conducting the manufacture and disposing of the waste products of the substances alluded to.

Instruction concerning the Precautions to be Taken when Repairs have to be Done to the Leaden Chambers of Sulphuric Acid Works.—Dr. Bontron.—This excellent paper contains a detailed account of the proper mode of managing the arrangements which have to be made when sulphuric acid chambers have to be repaired, so that accidents due to too great hurry in entering th chambers are prevented.

Archives Néerlandaises des Sciences Exactes et Naturelles Publiées par la Société Hollandaise des Sciences à Harlem, Vol. vi., No. 4, 1871.

This number contains the following original papers and memoirs relating to chemistry and allied sciences:—

Meteorite of Tjabé, Netherlands' India.—Dr. E. H. von Baumhauer.—This memoir contains, in the first place, a well authenticated account of the several phenomena which accompanied the fall of the meteorite just alluded to on the evening of Sept. 19, 1869. Nine hours after the fall of this stone it was yet so hot that it could not be touched by the hands; the weight of the mass amounted to some 20 kilos.; sp. gr. of this material, 3·456; separable by magnet, 14 per cent; sp. gr. of this portion at 15° = 6·8; relative proportion of nickel to iron in this part of the meteorite, 1 : 15. Composition of the silicated portion, in 100 parts—Insoluble in HCl, 50·14; sulphuret of iron, 3·71; silicic acid, 15·95; magnesia, 16·40; protoxide of iron, 12·01; lime, 0·74; soda, with a trace of potassa, 0·32; alumina, 0·22; protoxide of manganese, 0·30; protoxide of nickel, a trace. This exhaustive memoir also contains a series of observations on the methods of analysis of meteorites, and a comparative review between the composition of this stone and others fallen in Europe and analysed by other *savants*.

Relation Existing between the Rotatory Polarisation Power of Organic Bodies.—F. W. Krecke.—We regret that we can only quote here the headings of the different sections of this very lengthy monograph—Laws of rotatory polarisation; application of the laws of rotatory polarisation; carbohydrates, glucoses, saccharoids, sugars not capable of undergoing fermentation; other carbohydrates; glucosides; hydrocarbons and camphors; acids; alcohols; alkaloids of cinchona, strychnos, opium; constituents of bile; albuminoid substances. From the author's exhaustive and very carefully made researches, he deduces, as regards the molecular rotatory power of the different carbonated bodies *(corps carbonés)*, the following laws:—When an optically active body enters into combination with an optically inactive substance, or when the optically active body is modified by chemical reagents, the molecular rotatory power remains either unaltered or is altered in such a manner that the molecular rotatory power of the new body is a simple multiple of that of the generating body *(corps générateur)*; isomeric bodies possess molecular rotatory powers which are simple multiples of a same number.

Vol. vi., No. 5, 1871.

This number contains the following original memoirs and papers relating to chemistry and collateral sciences:—

Observations on the Microscopical Structure of the Cinchona Barks.—Dr. C. A. J. A. Oudemans.—This essay is a valuable contribution to our knowledge of the cinchona barks in general, and more especially those grown in Java.

Hygrometry at the Meteorological Observatories.—Dr. E. H. von Baumhauer.—The description, illustrated by engravings, of an instrument devised by the author, and termed an areometric hygrometer, by means of which the atmospheric moisture can be estimated exactly, and is recorded automatically and continuously.

Researches on the Origin and Chemical Constitution of the Terpèn Resins (Resins Proper).—A. P. N. Franchimont.—This exhaustive monograph treats, in the first place, on the mode of formation of the resins in plants; and, next, at very great length, on the chemical constitution of the resins. It is, however, impossible to enter here into further details, owing to the fact that this subject (treated *à main de maître*) is illustrated by several engraved plates.

Empiricism and Science: Historical Essay on Lavoisier.—Dr. J. W. Gunning.—A very interesting, valuable, and highly unprejudiced account of the real value of Lavoisier's knowledge and labours.

Bulletin de l'Academie Royale des Sciences, des Lettres et des Beaux Arts de Belgique, Nos. 9 and 10 (double number), 1871.

This number does not contain any original papers relating to chemistry.

American Journal of Pharmacy, January, 1872.

In addition to several very interesting original papers strictly relating to pharmacy, this number contains the following original chemical paper:—

Litmus-Paper as a Reagent.—C. Bullock.—This paper contains the results of a few experiments made by the author to solve approximatively the question, "What amount of acids or alkalies is necessary to give a distinct change of colour to the test-paper?" Blue litmus-paper should be distinctly blue, but not a deep shade, in colour; the directions given by Dr. Fresenius in his "Qualitative Analysis" will afford a sensitive paper. When carefully made it affords the reaction with one drop of acetic acid at 30 per cent in the following quantities of water:—In 4 ozs., it turns red immediately; in 6 ozs., completely red in half a minute; in 10 ozs., changes on the edge in one-fourth minute, and is completely reddened in 1 minute; in 13 ozs., it is completely red in 1¼ minutes, and remains red when dry; in 16 ozs. of water the limit of distinct reaction is found. Reddened litmus should have a purple-red colour, and the paper when dry a distinct red colour free from blue. With 1 grain of anhydrous carbonate of soda in 32 ozs. of water the paper turns blue in 1 minute; in 56 ozs. in 3 minutes in 64 ozs. in 4 minutes; in 80 ozs. in 7 minutes; in

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163 ozs. of water the limit of distinct reaction is found; the blue shade can be seen before the colour is dissolved from the paper. In these experiments the paper was submerged in the liquid.

Les Mondes, January 18, 1872.

New Physical Law.—A. Valson.—From the researches made by the author, he concludes the following is a new law in physics:—For all normal solutions—that is to say, those which contain each 1 equivalent of anhydrous salt, weighed in grammes, dissolved in 1 litre of water—the product of the density by the capillary height is perceptibly the same.

Autographic Telegraph Apparatus.—M. d'Arlincourt.—This paper contains a detailed account of the description and mode of manipulating a kind of apparatus which has been tried in France on a telegraphic line of which the two termini are 900 kilometres distant from each other; the velocity of transmission is the same as Hughes's apparatus (forty dispatches per hour); the results are said to be satisfactory in all respects.

Newly-Contrived Apparatus for Utilising the Force of the Wind.—M. Duros de Hauron.—A lengthy description, illustrated by engravings, of an apparatus which may be better than the construction of our well-known wind-mills.

January 25, 1872.

Oxyhydrogen Light.—Rev. F. Moigno.—From the few particulars communicated in this paper we quote that, by the use of a gas-burner consuming 32 litres (1·13014 English cubic feet) per hour of the coal-gas as supplied in Paris, and burnt by the aid of 16 litres of oxygen, there is produced a light equal to that of the Paris standard burner, consuming 140 litres of coal-gas per hour, while, with the aid of oxygen, the combustion is quite complete, and very much less heat generated; it is further stated that this process is 20 per cent cheaper than ordinary gas-lighting.

Improved Lamp-Glass for Moderator and Paraffin-Oil-Burning Lamps.—M. Lallemand.—In glasses of the ordinary shape and size are bored a number of very small holes, which cause jets of air to play upon the flame in such a manner as to accelerate, as well as render more complete, the combustion, while, at the same time, the glass is kept quite cool comparatively to those in ordinary use; there is also a far better and stronger light for the same consumption of oil.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, December 14, 1871.

Researches on the Fats of some of our Domestic Animals.—C. Méne.—The author gives us here, in tabulated form, the results of his very extensive researches on the specific gravity and points of solidification and of fusion of the fats of different races of bullocks, cows, sheep, pigs, calves, and lambs, and also compares his results with those obtained by other scientific chemists of older and of more recent date.

La Revue des Scientifique de la France et de l'Etranger, January 6, 1872.

This number does not contain any original papers relating to chemistry.

NOTES AND QUERIES.

Canadol.—(Reply to R. F.).—See CHEMICAL NEWS, vol. xxiv., pp. 145, 168. Canada oil is nothing else than highly rectified benzoline or petroleum spirit.

Induction Coil.—I have a battery of 50 Bunsens; zincs 5×3, carbons 6×1½×1½. How long ought the primary wire of an induction coil be, so that I can use my battery with it without fear of heating the coil and consequently making it useless, and also the No. of the thickness of the wire?—S. C. J.

Softening Water by means of Lime.—(Reply to W. R.)—The periodical you name is published at Augsburg, by the well-known firm of J. G. Cotta; any foreign bookseller will give you the information you ask for. As regards the second part of your question, you are referred to the original German paper you mention; of course the composition of the solid matter dissolved in the water will have to be studied.

Stannate of Soda.—(Reply to C.).—This salt is very frequently made by the dyers themselves according to receipts which answer their purpose best; its value depends chiefly upon the quantity of tin it contains. This salt is frequently met with adulterated with common salt; ordinary good amorphous stannate contains from 25 to 30 per cent of water. The price of this salt you will find quoted in dry-salters' price-lists.

Asbestos Cloth—Loss of Mercury.—Could you inform me where "asbestos cloth," a material used for making firemens' clothes, is procurable; at least, I believe it was suggested for the mentioned purpose. At the same time, do you know if it is a known fact that metallic mercury dissolves in pure sodic chloride? I am interested in the last particular very much, as I have *found* it to be. There is a loss of mercury in the American amalgamation process of obtaining silver by conversion into $HgCl_2$, but I think it is owing to—

$$Hg + 2AgCl = HgCl_2 + Ag_2$$

only. Could you supply me with the desired information I should be extremely obliged.—C. T. KINGZETT.

MEETINGS FOR THE WEEK.

MONDAY, Feb. 5th.—Royal Institution, 2. General Monthly Meeting.
—— London Institution, 4. Prof. Odling, F.R.S., on "Elementary Chemistry."
—— Anthropological, 8. Anniversary.
TUESDAY, 6th.—Royal Institution, 3. Dr. W. Rutherford, F.R.S.E., "On the Circulatory and Nervous Systems."
—— Civil Engineers, 8.
—— Zoological, 9.
WEDNESDAY, 7th.—Society of Arts, 8.
—— Geological, 8.
—— Microscopical, 8. Anniversary.
—— Pharmaceutical, 8.
THURSDAY, 8th.—Royal, 8.30.
—— Royal Society Club, 6.
—— Royal Institution, 3. Prof. Odling, F.R.S., "On the Chemistry of Alkalies and Alkali Manufacture."
—— London Institution, 7.30.
FRIDAY, 9th.—Royal Institution, 9. Prof. Humphry, F.R.S, "On Sleep."
—— Quekett Microscopical Club, 8.
—— Astronomical, 8. Anniversary.
SATURDAY, 10th.—Royal Institution, 3. Wm. B. Donne, "On the Theatre in Shakespeare's Time."

TO CORRESPONDENTS.

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THE

MANUFACTURE OF CHLORINE.

ALTHOUGH the development of the process for the Manufacture of Chlorine by means of oxides of manganese regenerated by means of magnesia, to which reference was made on this page some months ago, has been sorely delayed by serious ill-health on my part, I am nevertheless in a position to announce that that process, in a certain modified form which it has now assumed, has proved capable of yielding even more advantageous results than I formerly claimed for it. It will necessarily be yet some time before I can be able or free to supply working details. Meanwhile, I beg to report as follows :—

I. That the new form of process yields, in the free state, practically *all* the chlorine contained in the salt decomposed, being at about the rate of *a ton of bleaching-powder per fourteen hundredweights of salt.*

II. That, of the chlorine which it thus yields, a sufficient proportion to give a ton of bleaching-powder for about each thirty hundredweights of salt is ENTIRELY UNDILUTED, and therefore available for the manufacture of bleaching-powder in the chambers at present in use. This portion of the chlorine is generated in the ordinary (Weldon) stills, and is in precisely the same condition as that produced in my process as at present practised, or as that generated by means of native manganese.

III. That, while the remainder of the chlorine is *dilute*, it is not more so than that produced in any process yielding dilute chlorine only, and is free from carbonic acid, the sole diluent being nitrogen.

IV. That the process, in its new shape, is performed without blowing engines, and *without machinery of any kind*, by appliances already in use in every alkali-work, the only thing employed in it which has any "moving parts" being an ordinary liquor-pump.

The new form of process thus yields more *strong* chlorine, per given quantity of salt, than has ever hitherto been produced by any process whatever, and, in addition, yields the remainder of the chlorine in as good a state as the richest chlorine producible by any process which yields dilute chlorine only. While permitting the present production of bleaching-powder, per given quantity of salt, to be nearly *quadrupled*, it enables one-half of the quadrupled production to be made from undiluted chlorine, in such chambers as have been employed hitherto, and one-half of the chlorine to be generated in the present stills. Putting the whole cost of the process on the *strong* chlorine only, the cost of the latter, per ton of bleaching-powder, promises to be lower than it has ever been yet, the other half of the chlorine counting as not costing at all. Lastly, the special plant required for the new form of process is so simple and inexpensive, that the cost of a plant for any considerable production will probably not exceed £20 for each ton of bleaching-powder to be made by it per week.

WALTER WELDON.

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December 12th, 1871.

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THE CHEMICAL NEWS.

VOL. XXV. No. 637.

ON THE ELIMINATION OF ALCOHOL.*

By A. DUPRE, Ph.D.,
Lecturer on Chemistry at Westminster Hospital.

OBVIOUSLY three results may follow the ingestion of alcohol. All the alcohol may be oxidised and none be eliminated; or a portion only may be oxidised, and the rest be eliminated unaltered; or, lastly, all may be eliminated again unaltered. Assuming the last to be the case, it would follow that if a certain quantity of alcohol be taken daily, the amount eliminated would increase from day to day until, at last, the amount eliminated daily would equal the daily consumption, be this time five, ten, or more days. If, on the other hand, all the alcohol consumed is either oxidised or eliminated within twenty-four hours, no increase in the daily elimination will take place in consequence of the continuance of the alcohol diet. Guided by these considerations, the author undertook two series of experiments, in which the amount of alcohol eliminated by both kidneys and lungs was carefully estimated. The analytical processes employed are described in detail.

First Series.—After a total abstinence from alcohol for eleven days, the urine and breath were examined, after which, from the twelfth to the twenty-fourth day, both inclusive, the author took 112 c.c. of brandy daily (equal to 48·68 grms. absolute alcohol). The urine and breath were examined on the twelfth, the eighteenth, and the twenty-fourth day. The urine was also examined during the five days following the cessation of the alcohol diet. The analytical results obtained are given in a Table.

Second Series.—After having again abstained from the use of alcohol, in any shape, during ten days, the author took 56 c.c. of brandy (same as above) at 10 a.m. on March 29th. The urine was collected from three to three hours up to the twelfth, from the twelfth to the twenty-fourth, and during the next succeeding two days. The alcohol eliminated in the breath was also estimated during the same intervals. The analytical results are also arranged in a tabular form.

The results of both series may be summed up as follows:—

The amount of alcohol eliminated per day does not increase with the continuance of the alcohol diet; therefore all the alcohol consumed daily must, of necessity, be disposed of daily; and as it certainly is not eliminated within that time, it must be destroyed in the system.

The elimination of alcohol following the ingestion of a dose, or doses of alcohol ceases in from nine to twenty-four hours after the last dose has been taken.

The amount of alcohol eliminated, in both breath and urine, is a minute fraction only of the amount of alcohol taken.

In the course of these experiments, the author found that, after six weeks of total abstinence, and even in the case of a teetotaller, a substance is eliminated in the urine, and, perhaps, also in the breath, which, though apparently not alcohol, gives all the reactions ordinarily used for the detection of traces of alcohol, viz., it passes over with the first portions of the distillate, if yields acetic acid on oxidation, gives the emerald-green reaction with bichromate of potassium and strong sulphuric acid, yields iodoform, and its aqueous solution has a lower specific gravity and a higher vapour tension than pure water. The presence of a substance in human urine and the urine of various animals, which yields iodoform, but is not alcohol, had already been discovered by M. Lieben. The quantity present in urine is, however, so small that the precise nature of this substance has not as yet been determined.

Finally, the author points out an apparent connection between this substance and alcohol. It was found that, after the elimination due to the ingestion of alcohol had ceased, the amount of this substance eliminated in a given time at first remained below the quantity normally excreted, and only gradually rose again to the normal standard. A careful study of this connection may perhaps serve to throw some light upon the physiological action of alcohol.

* Abstract of a Paper read before the Royal Society.

A STUDY OF CERTAIN TUNGSTEN COMPOUNDS.*

By Professor HENRY E. ROSCOE, Ph.D., F.R.S., &c.

THE constitution of the tungsten compounds, the equivalent of the metal and even its elementary nature, are subjects upon which for many years serious doubts have been expressed. Thus Persoz, who at one time proposed to regard the so-called tungsten as containing two elements, at a subsequent date explained this by the assumption that the equivalent of tungsten and the formula of its highest oxide are not 184 and WO_3 respectively, but that the metal is one belonging to the arsenic group, having an atomic weight of 153, and forming a pentoxide and a pentachloride known as the tungstic compounds, together with a lower series which correspond to the lower arsenic compounds. This latter supposition, whilst unsupported by sufficient experimental evidence of its own to attract much attention from chemists, and contradicted by the important fact of the normal atomic heat of the metal corresponding to its old atomic weight, has never been satisfactorily proved to be incorrect, and has received a certain amount of corroboration from the subsequent vapour density determinations of the chloride of tungsten published by Debray. In this research Debray shows that the vapour density of tungstic chloride taken in mercury and sulphur vapours, is 168·5 (H = 1), the normal density for WCl_6 (W = 184) being 198·5; whereas that for Persoz's tungstic chloride, $TuCl_5$ (Tu = 153), is 165, closely corresponding to the experimental density.

In order to clear up these questions, a thorough investigation of the chlorides and oxychlorides of tungsten, together with the corresponding bromine and iodine compounds, appeared before all things necessary.

The author then describes the mode employed for preparing pure metallic tungsten, which was found to possess a sp. gr. of 19·261 at 12° C.

The Chlorides of Tungsten.

1. *Tungsten Hexachloride*, WCl_6.—For the preparation of this chloride in the pure state it is absolutely necessary to exclude every trace of air or moisture. For this purpose the metal must be burnt in a current of perfectly dry and air-free chlorine, otherwise red oxychloride is formed, and this cannot be separated from the chloride, owing to the slight differences in their boiling-points.

Metallic tungsten takes fire in chlorine at a moderate heat. On heating the tube containing the metal a granular sublimate of dark violet opaque crystals of the hexachloride makes its appearance, which, when prepared in quantity, collects as a dark blackish red liquid. In order to purify it, this liquid is distilled several times in excess of chlorine, and then slowly rectified in a stream of hydrogen, by which means any traces of adhering oxychloride can be got rid of.

* Read before the Manchester Literary and Philosophical Society January 23, 1872.

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The dark violet-coloured crystals decrepitate on cooling, and the mass falls to a crystalline powder. When pure the solid hexachloride does not undergo any change, even in moist air, but in presence of the smallest trace of oxychloride it at once absorbs moisture, evolving fumes of hydrochloric acid, and changes from a violet to a brown colour. Cold water also acts very slowly on the pure substance, but, if impure, the mass is at once decomposed by cold water into a greenish oxide. The hexachloride is readily soluble in carbon disulphide, from which it is deposited in hexagonal plates. On several occasions the tubes containing the crystalline chloride exploded on opening them with a file, the crystals suddenly assuming the form of the decrepitated substance.

On decomposition with hot water a small quantity of chlorine is invariably retained by the tungstic acid formed, even after repeated distillation with water. Hence it was necessary in the analysis to reduce the oxide to metal and to collect the hydrochloric acid formed. This was effected by covering the weighed chloride in a porcelain boat with water, and bringing it into a bent combustion tube, one end of which was connected with a hydrogen evolution apparatus, and the other with a flask of water in which the acid was collected. On gently heating the fore part of the tube (the greatest care being taken to prevent spirting) the chloride is converted into the yellow oxide, after which it was more strongly heated and the reduced metallic tungsten weighed whilst the chlorine was estimated with silver.

Six analyses of different material, prepared on different occasions and according to different methods, yielded the following results:—

		Calculated.	Found.
Tungsten, W.. ..	184	46·35	46·49
Chlorine, Cl_6.. ..	213	53·65	53·32
	397	100·00	99·81

The exact determination of the melting-point of the hexachloride is attended with some difficulty, as the liquefaction takes place gradually, and the smallest traces of impurity depress the melting-point down to about 180° C., that given by the older observers. A mean of several experiments gave the number 275° C. (corrected) as the melting-point and 270° as the point of solidification. The constant boiling-point of the hexachloride was found to be 346·7° (corr.) under 759·5 m.m. of mercury. The vapour density of the hexachloride was determined (1) in sulphur vapour at 440°, and (2) in mercury vapour at 350°. As the hexachloride always leaves, on distillation, a small quantity of solid residue, the substance was distilled (either in a current of carbonic acid or of chlorine) into the heated bulb from a smaller one attached to it, according to the method adopted by the author in the determination of the vapour density of vanadium tetrachloride. The narrow neck of the bulb was kept open during the experiment by inserting a platinum wire, and after the sulphur or the mercury had been boiling for some minutes the neck was sealed.

The results of three experiments in sulphur vapour at 440° gave the density (H=1) as (1) 167·8, (2) 169·7, (3) 168·8. Two determinations in mercury vapour at 350° gave (1) 190·7, (2) 191·2.* The fact of the alteration of the vapour density from 190 at 350° (closely approaching the normal density, 198·5) to 167 at 440° shows pretty clearly that the anomalous vapour density is to be ascribed rather to dissociation than explained by Persoz's suggestion of an error in the atomic weight; and this conclusion is fully borne out by further experiments detailed in the sequel.

The residual chloride from the bulb possesses the same properties and composition as the original substance, there is no trace of free chlorine found in the cold bulb, nor does the colour of the vapour of the hexachloride change when it is strongly heated.

On heating the residue with water, a difference between its behaviour and that of the original hexachloride can, however, be detected, as the residue yielded an oxide which was perfectly yellow, but had a greenish colour, showing the existence of traces of oxides lower than WO_3, although present in too small quantity to affect the analysis.

In order to ascertain whether the gaseous hexachloride is decomposed at high temperatures, a portion of the pure chloride was distilled upwards in a current of dry carbonic acid for several hours. A continuous liberation of chlorine was clearly shown to occur, for, on passing the exit carbonic acid through a solution of potassium iodide, considerable quantities of iodine were liberated. The residual chloride was tested for lower chlorides by titrating a weighed quantity with a standard permanganate solution, which readily oxidises the blue oxide formed by the action of water on the pentachloride into tungstic acid. In one experiment thus conducted the residual chloride contained 3·3 per cent of pentachloride, whilst in another no less than 24·6 per cent of the pentachloride was formed. The pentachloride treated in a similar way yields no free chlorine, and therefore does not undergo a similar decomposition at high temperatures.

2. *Tungsten Pentachloride*, WCl_5.—On distilling the hexachloride in a current of hydrogen a reduction always takes place. If the temperature be kept but little above the boiling-point of the hexachloride, the dark red colour of the vapour is seen to vanish, and a light yellow-coloured vapour makes its appearance, which soon condenses into black drops or long shining black needles. After two or three distillations in hydrogen a pure product is obtained. Tungsten pentachloride crystallises in long black shining needles; if condensed in fine powder its colour is dark green, and the powdered crystals also possess a dark green colour like that of potassium manganate. The pentachloride is exceedingly hygroscopic, the crystals becoming instantly covered with a dark golden-green film on exposure to air, and small particles being instantly converted into drops. The crystals do not decrepitate like those of the hexachloride. On treatment with larger quantities of water the pentachloride gives rise to an olive-green solution, although the greater part of the chloride forms the blue oxide and hydrochloric acid. Analyses made with three separate preparations, according to the method already described, gave the following mean result:—

		Calculated.	Found.
Tungsten.. ..	W = 184·0	50·89	50·90
Chlorine	Cl_5 = 177·5	49·11	48·58
	361·5	100·00	99·48

Tungsten pentachloride melts completely at 248° C., and solidifies at 242°; the boiling-point is 275·6° (corr.). The vapour density of this chloride taken in sulphur vapour at 440° was found to be (1) 186·4, (2) 186·5, (3) 185·7; the normal calculated density (H=1) being 180·7.

Hence the molecule of pentachloride contains one atom (W=184) of metal.

3. *Tungsten Tetrachloride*, WCl_4.—The tetrachloride forms the non-volatile residue produced in the distillation of the hexachloride in hydrogen. In order to obtain it in a pure state the mixture of the two higher chlorides is distilled at a low temperature (best in a bath of melted sulphur) and in a current of dry hydrogen or carbonic acid. The tetrachloride is a loose soft crystalline powder of a greyish brown colour. It is highly hygroscopic, but not so much so as the pentachloride, and it is partially decomposed by cold water into brown oxide and hydrochloric acid, forming also a greenish brown solution which is rather more stable than the green solutions of the pentachloride in water. The tetrachloride is non-volatile and infusible under ordinary pressure, but it is

* Rieth has lately determined the vapour density of "wolfram chlorid," showing that its molecule contains 187 instead of 184 of metal, but there is nothing to show whether the substance thus examined was the hexa- or the penta-chloride.

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decomposed on heating into pentachloride, which distils off, and a lower dichloride which remains behind. On heating in hydrogen at a temperature above the melting-point of zinc, the tetrachloride is reduced to metallic tungsten, which is sometimes deposited as a black tinder-like mass, undergoing spontaneous ignition on exposure to the air.

Analyses of four portions gave the following mean numbers:—

		Calculated.	Found.
Tungsten	W = 184	56·45	57·22
Chlorine	Cl_4 = 142	43·55	42·24
	326	100·00	99·46

4. *Tungsten Dichloride*, WCl_2.—This body is formed in light grey crusts on reducing the hexachloride at high temperatures. It can be best prepared from the tetrachloride by heating in a moderately hot zinc bath.

The dichloride is a non-volatile loose grey powder, without lustre or crystalline structure. It undergoes change on short exposure to air, and is converted by water into brown oxide, with evolution of hydrogen. Analyses of two preparations gave as follows:—

		Calculated.	Found.
Tungsten	W = 184	72·15	73·00
Chlorine	Cl_2 = 71	27·85	26·35
	255	100·00	99·35

Experiments made in the endeavour to prepare the chlorides WCl_3 and WCl were unsuccessful.

5. *Tungsten Oxychlorides.* — The monoxychloride, $WOCl_4$, and the dioxychloride, WO_2Cl_2, have already been tolerably fully studied, nevertheless we find that Persoz actually doubts the existence of these well characterised compounds, and Debray, obtaining abnormal numbers for the vapour density of the first of these bodies, is unable to explain his results.

The splendid ruby-red needles of the monoxychloride are best obtained by passing the vapour of a chloride over heated oxide or dioxychloride in a current of chlorine. The crystals melt at 210·4°, and solidify at 206·7°; when heated more strongly the liquid boils at 227·5° C. (corrected) forming a red vapour rather lighter coloured than that of the hexachloride. On repeated distillation in chlorine over charcoal the hexachloride is formed. On exposure to air, the red crystals become at once coated with a yellow crust of the dioxychloride.

Analysis gave—

		Calculated.	Found.
Tungsten	W = 53·80		53·89
Chlorine	Cl_4 = 41·52		41·11
Oxygen	O = 4·68		
	100·00		

Debray found the vapour density of this body in sulphur vapour to be 148 (H = 1), whereas the calculated density is 171. On repeating this determination, the numbers (1) 171·3 and (2) 171·7 were obtained; whilst experiments made in mercury vapour gave (1) 175·8, (2) 170·8, proving that the vapour density of the monoxychloride is normal, and that the molecule of this substance contains 184 parts of metal.

The Dioxychloride, WO_2Cl_2, is best prepared by passing chlorine over the brown dioxide. Analysis gave—

		Calculated.	Found.
Tungsten	W = 64·32		64·11
Chlorine	Cl_2 = 24·31		24·74
Oxygen	O_2 = 11·37		
	100·00		

The vapour density of the dioxychloride cannot be determined at 440°, as at that temperature the contents of the bulb remains liquid.

(To be continued).

ON THE

ATOMIC WEIGHTS OF THE CHEMICAL ELEMENTS.

By S. E. PHILLIPS.

THE subject of this paper is one upon which a considerable interest has been evinced, and the object of the writer is rather to ascertain *the truth* than to manifest a one-sided advocacy.

That many able men have endorsed the new views there can be no question, and that they should be wholly in error is extremely improbable; it is, however, to be lamented that some have evinced a tone of offensive superiority and assumption totally unwarranted.

In England especially the new views have become almost universally acknowledged; and it is no less clear that a wide feeling of dissatisfaction is felt, in regard to the variety and complexity of formulæ involved.

The great Dumas hesitates not to confess inability to read modern chemical memoirs on account of the complexity of formulæ indulged in, and the "barbarous" character of the nomenclature employed.

Professor Odling has eloquently rebuked the unwarranted liberties taken in the curious art of type building speculations, and the President of the Chemical Society has lifted up his voice against the notion of bonds, atomicities, &c., &c.

Professor Wanklyn, an eminent worker in the new field, says—"That the present formulæ (the doubled or diatomic), for salts of barium, calcium, magnesia, &c., should have come into general use, and that there should be next to no experimental support for these formulæ is a most extraordinary thing.

"The reasons in regard to some of these metals were partly some very doubtful deductions drawn from their specific heats, and mainly from considerations of the vapour density of certain metallic compounds."

Old Views.

Electro-combining equivalents have been determined by a varied scrutiny of the relative weights of atomic combinations as checked by all other available sources of rectification.

It is in this way the atomic weights have been established on the assumption that the ultimate atoms of bodies have their specific weights as H = 1, O = 8, Water = 9, Mercury = 200, &c.

Atomic Volumes.

It was long ago seen that an intimate relation subsists between the atomic weights and their specific volumes or vapour densities. It is, however, unfortunate that only a few of the elements are capable of admeasurement in the state of vapour, but indirect methods and theoretical determinations have justly added a value and interest to this class of atomic considerations. And whether modern chemists have laid too much stress on its guidance, apart from wider elements of control, is a fair question.

The law as at first proclaimed was, that equal volumes at equal pressure and temperature contained the same number of atoms. This is now understood as referring more to molecules than atoms.

In deference to this hypothetic law, because oxygen had only half the standard volume, its atomic weight was doubled, and similarly with other elements, water becoming $\left.\begin{matrix}H\\H\end{matrix}\right\}\Theta = 18$ instead of HO = 9.

As in atomic chemistry it is seen that combinations take place, mostly in ratios of 1 to 1, but sometimes 1 to 2, or 1 to 3 (the inverse being 1 to ½, 1 to ⅓, &c.), so in like manner we now moot that the same principle predominates in the other affections of matter now under consideration.

As in the law of specific heats or that of refractive

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energies, so it would appear that volumetric combinations illustrate the same principle, not only at the onset, or in regard to the combining constituents, but also in regard to the products of combination. A few instances will show this—

H+Cl=HCl, the resulting chlorhydric acid being precisely the volume of its constituents; in other words, there is no condensation.

H+O=HO, where 1½ volumes are condensed to one of water vapour.

C+2O=CO_2, where two equal volumes of carbon and oxygen are condensed to one of carbonic acid gas, &c.

Saltic compounds mostly affect two vols., but this rule is far from being universal, as may be seen in the silicate of ethyl (silicic ether) and many others.

2EO+SiO_2 = silicate of ethyl, whose vapour density is 105·7; the atomic weight = 104; therefore a saltic condensation of 3 to 1, &c.

The process of halving or doubling old atomic weights to obviate anomalies could never have been tolerated but for the strange fatality which has attended the change—viz., that by a parallel movement all the chemical or dynamical considerations involved in electro-chemistry have been laid aside. Given a number of skittles with no inherent qualities beyond such as are derived from their attidude or position in the type, and it is at once seen what a wide scope there is for the varied numerical pleasantries which continue to be so prolific.

A striking illustration of this may be seen in the popular "Outline of Modern Chemistry," by Professor Hoffman. He uses the word *chemism* to express the dynamical or atomic forces involved, as we think, in all chemical phenomena; but the reference is only made once, and near the end of the book, and then only in a parenthetical way, as if to show its irrelevance while pourtraying the atomic mechanism of varied atomicities, varied quantivalences, atom-fixing powers, &c.

A reaction between oxide of silver and binoxide of hydrogen has given rise to much speculation, the character of which may be seen in the following equation:—

$$\underset{+-}{AgO}+\underset{+-+}{HOO}=Ag,\ HO,\text{ and }\underset{-+}{OO}$$

where it is seen that free oxygen gas is considered an electro-binary, and this view is extended to other bodies. Thus—

$$\underset{+-}{HH}+\underset{+-\ +-}{OO}=HO,\ HO.$$

It is indeed anomalous that men who have laid aside electro-binary principles, in favour of every conceivable form of numerical representation, should now so quixotically run a tilt at the grave of Berzelius, and apply to similar that which has been denied for opposite elements.

In another connection we have asked what can be the difference between 1 atom water—

$$\left.\begin{matrix}H\\H\end{matrix}\right\}\Theta$$

2 atom water—

$$\left.\begin{matrix}H\\H\\H\\H\end{matrix}\right\}\begin{matrix}\Theta\\\Theta\end{matrix}$$

up to 14 atom water; and we would now enquire if in the electro-decomposition of—

$$\underset{-+}{HO}$$

they ever expect to get the *negative* H given off at the zinc pole, and *vice versa* with the *positive* O.

It may seem strange that oxygen should be ½ vol. while its chemical analogue, Cl, like that of H, is 1 vol., but this character of anomaly is of frequent occurrence both with elements and compounds.

Nitrogen is 1 vol.; phosphorus and arsenic are ½ vols., but they are strictly congeners, and the difficulty vanishes in their compounds.

	Vols.	Density.	Atomic Weight.
3H+N=Ammonia	2	8·5	17
3H+P=Phosphonia ..	2	16·8	34
&c.,	&c.		

The case of oxygen is strictly analogous.

HO	1	9·0	9·0
CO	1	13·9	14·0
SnCl	1	(?)	94·5
CCl	½	84·0	41·5
SCl	1	67·8	67·5
&c.,	&c.		

As modern chemists have, perhaps, unwisely abandoned the method of indicating the doubled atoms by a cross line (thereby occasioning great trouble to some who either do not or will not understand the new arrangements), I have adopted it with a new signification. It bespeaks an atom of double weight or condensation, but which is not a duad in the modern acceptation—viz., it does not represent the equivalence of 2H, &c. (CHEMICAL NEWS, vol. xxi., p. 123).

An extended series of binoxides, bichlorides, &c., also agree.

		Vol.	Density.	Atomic Weight.
Carbonic acid,	CO_2 ..	1	22·10	22·00
Silicic acid,	SiO_2 ..	1	(?)	30·00
Stannic acid,	SnO_2 ..	1	(?)	75·00
Sulpho-carbonic,	CS_2 ..	1	38·20	38·00
Chlor-carbonic,	CCl_2 ..	1	76·50	77·00
	$ZrCl_2$ ..	1	167·20	165·50
	$SiCl_2$ ..	1	84·70	85·00
	$TiCl_2$ ..	1	98·70	96·00
	$SnCl_2$ ..	1	132·80	130·00
	SiI_2 ..	1	19·12	18·56
	CoCl ..	1	49·10	49·50

I presume that many of the sesqui-ides also affect 1 vol. oxalic acid—

C_2O_3 ..	1	—	36·0
C_2Cl_3 ..	1	117·7	118·5 solid.
C_2Cl_3 ..	2	58·8	118·5 liquid.
Al_2Cl_3	1	134·8	134·0
Al_2I_3 ..	1	389·9	408·5
Al_2Br_3	1	268·8	267·5
Fe_2Cl_3	1	164·4	162·5
Cr_2O_3 ..	1?	—	50·3
CrO_2Cl	1	80·0	77·8

with reference to the volumetric character of the compounds of O, Cl, and H, we might put the matter succinctly thus—

Vol.	Vol.	Vol.
CO_2 .. 1	CH_2 .. 1	CCl_2 .. 1
C_2O_3 .. 1	C_2H_3 .. 1	C_2Cl_3 .. 1

The rule seems to be that proto-, bi-, and sesqui-ides mostly affect 1 vol., though with some exceptions, but with the ter-ides the rule seems to favour 2 vols.

	Vol.		
$BoCl_3$	2	56·8	117·5
$SbCl_3$	2	112·6	228·5
SbE_3	2	104·4	209·0
$BoMe_3$	2	27·9	56·0
$BoBr_3$	2	176·8	251·0
	&c.,	&c.	

The same general symmetry with like departures may be abundantly traced in organic chemistry—of hydrides it may probably be affirmed that they always affect 2 vols.

$(C_4H_3O_2)$,H	2	22·04″	44
$(C_4H_3Cl_2)$,H	2	49·07″	99
&c.,	&c.		

It is plain, therefore, that when we isolate these radicals, their volumes will correspond with 1 vol., and their densities be strictly that of their atomic weights.

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H	1	1	1
$(C_4H_3O_2)$	1	43	43
$(C_4H_3Cl_2)$	1	98	98
(C_4H_5)	1	29	29
&c.,		&c.	

It is now pretty well accepted that oxygen has a density of 16, while that of allotropic O as given off by electrolysis is 24, also that ordinary sulphur is 96, while that subjected to a temperature of 1900° is 32.

H	1	1	1
Oxygen	½	16	8
Ozone	¼	24	8
Sulphur	¼	96	16
Do. at 1900° F...	½	32	16

According to Ludwig the density of Cl as deduced from its atomic weight of 35·379 would be 2·45012.

At 20° C. he found 2·4807
,, 100° C. ,, 2·4685
,, 200° C. ,, 2·4502

In a paper on "Some New Sulpho-Salts" (CHEMICAL NEWS, vol. xxi., p. 122) I have referred to the allotropic or doubly condensed forms of copper, ammonia, carbonic oxide, &c., and the subject well demands a fuller investigation.

In both idic and saltic forms of combination, one of Cu (31·75) may be replaced to the preservation of the same type by an atom of Cu (63·5), and in the case of CO (14) and H_3N (17) when replaced by $C\Theta$ (28) and H_3N (34), it is quite clear that not only are the types preserved but the volumes also.

This feeble glance at a subject so profound in its wide and important bearings, may well justify caution in halving or doubling atoms to satisfy any preconceived theory on the subject.

Specific Heats.

The rudest cook would readily perceive that, in boiling different fluids, varying amounts of heat are requisite, and closer investigation has shown, that while different elements require varying amounts of heat to raise equal weights 1°, yet within certain limits, that if these uniform weights be varied to correspond with their atomic weights, then the heat required to raise the substance 1° would be uniform and equal. Thus—

	Specific heat.
Water	1
Potassium	0·1696 × 39 = 6·61
Sodium	0·2934 × 23 = 6·75
Lithium	0·9408 × 7 = 6·59

Of course it is tempting to find herein the expression of universal law, but further examination will show that this has not yet been realised, and we are perplexingly confronted with the same ratios of half and other multiple variations.

The alkaline group gives a fair approximation to a mean constant of 6·65, but while O had its atomic weight doubled to square with volumetric consideration, the specific heat is 0·2175, which multiplied by 16 only gives 3·4 instead of 6·5 ! So that if we must get the specific heat right, then the vol. is as much too great as it was originally too small!

Then, again, if the specific heat of N and O (even when the latter is doubled) is too small, we find that of mercury and cadmium to be too great. Bloxam says—"the specific heat of mercury is twice as great as it should be if its atomic weight be 100, and this conjoined with *other considerations*, has led many chemists to adopt 200 as its atomic weight."

Here, then, is another dilemma. Old Chemistry said mercury was 200°; New Chemistry, after doubling several atoms, said this volume is too great, we must halve the atomic weight, and then, when numerous books and manuals of the science have been disfigured, Mr. Specific Heat steps in, and, with warmest assurance, states it right after all!

If we take H,Cu—Pb,Tl—Ba,Li, Old Chemistry teaches that while not a definitely select group, yet that these closely connected pairs all evince many characters in common. They all form protoxide bases, and mutually replace each other in similar saltic types, in the ratio of their atomic weights, but in electro-position and the further minutiæ of chemical characters, they constitute three pairs of closely allied elements. Their volumes we know not, but their specific heats do not conform to the law.

Lithium corresponds, but barium is about ½, and hence its weight is doubled, and the symmetry of the plainest chemical analogies is violated, and the so-called protoxide and protochloride become $Ba\Theta$ and $BaCl_2$!

Thallium corresponds to theory, but lead, its perfect analogue, is about half, and hence its double weight and violated analogies.

H and Cu both correspond to about half values, but, strange to say, copper is doubled, while H is left alone in its half glory !

Then, again, if we take Cl and Br, two of the very closest chemical analogues with well-established atomic weights, and which correspond to equal volumes, yet here is an anomaly which no halving or doubling can rectify—

Cl = 4·309
Br = 6·746

Br has been considered 4·416, but recent researches with a varied temperature have given 6·74.

To get this, however, a temperature of 78° C. is necessary, and, as some elements require a temperature of 100° C. to approximate theory, here we have a difference of about 300° F, which detracts somewhat from the generality and close applicability of the supposed law.

As the temperature of the volumetric determination is a very vague element, so a like variation occurs with specific heat, and it is not a little curious that this should also point towards multiple ratios. If water be 1, then ice is ½ !

Specific Refractive Energies.

This subject is comparatively a new one, and has not yet been reduced to the level of a popular comprehension. The following is a very imperfect attempt to digest the results communicated to the Chemical Society by Dr. Gladstone:—

(1). The influence of temperature on the refraction of light by liquids decreases as the temperature rises, but there is a relation between the change of density and the change of refractive index, minus unity; whence the refractive energy becomes $v-1$, and this, divided by the density, gives the specific refractive energy a constant unaffected by temperature.

(2). As to combinations, compared with their constituents, Dulong essayed to show that the power of a mixture was the mean of its constituents, but we find the nearest approach to truth is given by $\frac{v-1}{d}$.

An element seems to retain its specific power of retarding rays when it is combined with other elements: the law appears to be that the power of any liquid is the sum of its constituents modified by the manner of combination.*

(3). As to different homologous compounds.

In the methyl series, the power increases as the series advances, the refraction equivalent becomes $\frac{v-1}{d} \times$ by the atomic weight. The equivalent of C = 5, H = 1·3, Θ = 3, Thus ether = $C_4H_{10}\Theta = 4(5) + 10(1·3) + 3 = 36$, and observation gives 36·26; but there are exceptions, the aromatic hydrocarbons and others greatly exceed the calculated numbers.

Fifty elements have been thus determined; some have a double value, and, in most cases, this is coincident with

* Professor Andrews, in his inaugural address at the British Association last year, says,—"Later researches have shown that the specific refractive power depends chiefly on the atomic composition of the body, and is little influenced by the mode of grouping of the atoms.

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a change of atomicity. Iron in the ferrous salts is 12·0, in the ferric salts 20·1; the iron of ferridcyanide of potassium = 11·7; and is therefore in the same condition as is the ferrous salts.

Oxygen presents great anomalies; in many cases it gives 2·9, in others 2·1, and in some a negative quantity!

It is remarkable that similar atomic weights give similar refraction equivalents, and this is the more striking when the specific refractive energies are compared—

	Atomic weight.	R. equivalent.	Sp. R. energy.
Iron, Fe	= 56·0	12—20·1	0·214
Manganese, Mn	= 55·0	12·2—26·2	0·222
Aluminium, Al	= 27·5	8·4	0·307
Chromium, Cr	= 52·5	15·9—23·0	0·305
Bromine, Br	= 80·0	15·3—16·9	0·191
Iodine, I	= 127·0	24·5—27·2	0·193

But the most suggestive comparison is that between the specific refractive energies and the combining proportions of those metals that form salts not decomposable with water. (The actual amount which combines with a certain quantity of the salt radical).

	Specific refractive energy.	Proportion.	Atomic weight. Old.	Atomic weight. New.
H	1300	1·0	1·00	1·0
Al	307	9·1	13·75	27·5
Ca	260	20	20·00	40·0
Fe	214	28	28·00	56·0
Na	209	23	23·00	23·0
K..	207	39·1	39·10	32·1
Cu	183	31·7	31·70	63·5
Ag	125	108	108·00	108·0
Pb	120	103	103·50	207·0

This suggests that the combining proportions of silver, lead, &c., ought to be halved in order to bring these elements to about their right places in the list.

It is with much diffidence I make any remarks on a subject so little matured, but while the halving of elements seems very cogent in regard to the doubled or diatomic cases of the atomic lists which I have appended, still I do not see why silver and potassium should be thus interfered with. Nor can I see in the previous lists either the similarity of weights or that of refraction equivalents, and the whole matter, as in the previous sections, seems to demand a much fuller investigation before any rash liberties be taken with the chemical alphabet.

The ferrous salts are, in all probability, $FeO+SO_3$
The ferric salts " " $Fe_2O_3+3SO_3$
The ferridcyanides " " $3KCy+Fe_2Cy_3$

If this be right, it is opposed to the indication above given.

A subsequent memoir was read on the refraction equivalents of the aromatic hydrocarbons and their derivatives, in which is given an extended list of these bodies, the general results being that—

The essential oils are about 2 higher than theory
The phenyl group " " 6 " "
The naphthalen group " 14 " "
The anthracen " " 17 " "

Electrolytic and Calorific Relations.

By the very strict conditions of electrolytic interchange, it must happen that hereby is afforded a valid and crucial test of the relative weight of elementary bodies, and whether we consult the "Lecture Notes" of Professor Tyndall, or refer to any modern estimates, as apart from all attempt at theoretical explanation, we find a set of numbers fully in accordance with the old chemism of the subject—a class of consideration which perhaps far outweighs all the others in force and value, but which I cannot include within the limits of this sketch. Those numbers are as O=8, H=1, Zn=32·5, K=39·1, Cu=31·75, &c.

Nor is there less of force and cogency in the laws of calorific energy.

It is very generally accepted that the electro-motive force is due to the difference of potential between the elements of any given battery equation and therefore it comes to the same thing whether we estimate this potential from an electric or from a calorific point of view.

If we employ zinc as the motor element in a battery we get a certain force of current; if we replace it with sodium we get a greater force; and if we employ potassium we obtain a force of current stronger in the ratio of its greater electro-remoteness from the negative or opposite oxygen. On this point the physicist is more advanced than the electrician, although his means of quantitative research are greatly more difficult.

He has determined with approximate precision the heat evolved in the combustion with oxygen of the several elements. We only cite two or three for illustration—

Hydrogen	1	= 34262
Zinc	32·5	= 42282
Sodium	23	= 73510
Potassium	39·1	= 76238

Now if zinc were really the diatomic of modern theory, and its smallest proportional weight were 63, then its calorific value as contended for by some would be 84564, or greater than that of the more energetic potassium, which is simply preposterous.

We are about to have an Electrical Society, which promises well for force and vitality, but in addition to the reproach involved in the above figures, and while other nations have electrical periodicals of high standing, it is lamentable that we have no journal devoted to such an important department, where England, impelled by a practical and pecuniary instinct, is constructing a nervous communication throughout the entire globe.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, February 1st, 1872.

Dr. Frankland, F.R.S., President, in the Chair.

After the minutes of the previous meeting had been read and confirmed, Messrs. Eltoft, Gerstl, Helm, and Martindale, and Lieut. Abney, were formally admitted members of the Society.

The following names were then read for the first time:—Messrs. Henry Baden Pritchard, James Ballantyne Hannay, J. Vincent Taylor, Robert William Atkinson, and Walter William Fisher, B.A.

For the second time—Lüdwig Mond, E. Packard, jun., J. Ruffle, F. J. Barrett, E. Handfield Morton, Ross Scott, M.A., and Edward Kinch.

For the third time—Professor William H. Chandler, Professor Charles F. Chandler, Ph.D., Benjamin P. Medcalf, and John Watts, D.Sc., who were then balloted for and duly elected.

A "*Note on the Crystalline Principle of Barbadoes Aloes*" was read by the author, W. A. Tilden, D.Sc., who, after referring to Dr. Stenhouse's examination of aloïn, stated that he had succeeded in obtaining from it a crystalline chlorine substitution compound by following the method employed by Stenhouse in chlorinating orcin, viz., by means of potassium chlorate and hydrochloric acid. The formula of the chloraloïn was—

$$C_{17}H_{15}Cl_3O_7,3H_2O,$$

which bears a temperature of 120° without decomposition, but loses the three of water. It is somewhat more soluble in boiling water than the corresponding bromine compound, crystallising out on cooling in long silky yellow needles; when treated with nitric acid and silver nitrate it furnishes oxalic and picric acids, but no chrysamic acid, whilst the original aloïn, when acted on by nitric acid, yields, besides oxalic and picric acids, nearly 40 per

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cent of chrysamic acid. As the reactions of aloïn, as well as its bromine and chlorine derivatives, show a marked analogy to those of orcin, the author intends extending the investigation.

The PRESIDENT thanked the author, in the name of the Society, for his interesting paper, and hoped that he would continue his researches on aloïn, as it would be very advantageous that this compound, which had, as it were, been wandering about so long without a place, should be classified.

A paper was then read by C. R. A. WRIGHT, D.Sc. "*On the Relations between the Atomic Hypothesis and the Condensed Symbolic Expression of Chemical Facts and Changes known as Dissected (Structural) Formulæ.*" As it is impossible in the space at our disposal to give anything like a complete abstract of this elaborate paper, we must be content with placing before our readers a brief outline comprising the principal points. The author, after stating that the natural method of discussing any given hypothesis was first to enumerate facts and then to enunciate the theory, and show how far it accounted for these facts, proceeded to give definitions of the terms employed, a "*relative vapour volume unit*," or more briefly a "*volume*," being defined as the volume occupied by 1 grm. of hydrogen under given conditions, whilst the terms "specific gravity of vapours" referred to hydrogen, "element," "compound," and "allotropic modification of an element" are taken in the usual sense. The "combining number" of an element is the smallest number of grms. of that element contained in two volumes of the homogeneous vapour of any of its compounds, and the collocation of symbols and suffixes which express the quantitative composition of a compound by weight as well as by volume is termed a formula. In the case of most elements, moreover, it has been ascertained that their combining numbers are approximately inversely proportional to their specific heats, so that it may be said that the formulæ of bodies are fixed, from considerations of their quantitative volumetric composition in the case of volatile compounds, specific heat of non-volatile elements, and generalisations, analogies, and conventions of various kinds, occasionally leading to higher formulæ than the simplest integral formula. The author then discussed the question of isomorphism and the relation between the specific gravity, specific refractive energy, and boiling-point of a body and its formula, and went on to say that chemical reactions might be expressed by equations in which one or more formulæ occur on each side of the sign of equality: the most general form of such equation being $AB+CD=AC+BD$, where A, B, C, D, represent portions of formulæ which are associated together differently in the resulting products from what they are in the generators. If AB, CD, AC, BD, are the formulæ of two generators and two products respectively; the reaction is said to be one of *double decomposition*, and the portions of formulæ A, B, C, D, are termed *groups* or *radicals*, so that the radical is one or more symbols and suffixes capable of being transferred from one formula to another, the process indicated by this transfer being a chemical reaction. Before, however, it can be asserted that two bodies contain a common radical, a reaction must be formed whereby one of them is converted into the other; thus, water, caustic soda, and acetic acid are all said to contain the radical hydroxyl because of the following reactions:—

$$2H_2O+2Na=H_2+2NaOH,$$
$$NaOH+C_2H_3OCl=NACl+C_2H_3O,OH,$$
$$C_2H_3OCl+H_2O=HCl+C_2H_3O,OH,$$

and similarly since the action of acetyl chloride on alcohol produces hydrogen chloride and acetic ether, it is inferred that the latter compound contains C_2H_3O, O, and C_2H_5, which may be represented by the *dissected formula* $C_2H_3O-O-C_2H_5$. Again, the action of water on acetyl chloride gives rise to the dissected formula C_2H_3O,OH and, whilst the production of this acid from methyl cyanide gives rise to the differently dissected formula CH_3,CO_2H, but both these are expressed by the dissected formula CH_3,CO,OH. It is usually found, therefore, that formulæ thus dissected into very simple groups are capable of expressing all the reactions of the body in question.

In the latter part of his paper the author treats of the relations of the atomic hypothesis to the facts just mentioned as summed up in the symbolic expressions termed dissected formulæ, and shows how far these facts may be accounted for by the atomic hypothesis, distinctly stating, however, that the dissected formula of a compound does not represent, in space, the relative positions of the compound atoms, his endeavour having been to express as briefly as possible all the principle chemical facts involved in the discussion, in language unconnected with any theory, and then to show how far the atomic hypothesis is in accordance with these facts, and, that as the language of this hypothesis is not necessary for the enumeration of chemical facts, it would be desirable that it should be kept in its proper place in text-books, *i.e.*, after the enumeration of fundamental facts in language independent of theories, the atomic hypothesis should be mentioned as accounting for certain of these facts, and then dismissed from consideration.

On the conclusion of the paper a long and very interesting discussion ensued.

The PRESIDENT said that it was quite unnecessary to ask the Society to return thanks to Dr. Wright for his paper, as he knew they would all agree with him how necessary it was to recur to those fundamental facts upon which the huge superstructure of chemical science rests, but he thought that the atomic theory had assisted in clearly placing before our minds certain facts, and it was probable that without it we should not have made the progress we had done, considering the facility with which it lent itself to the expression of the various reactions of chemical compounds. He agreed with the author as to the loose and inaccurate manner in which the term atom was frequently employed not only to indicate the smallest portion of an element, but also groups of elements: it was, moreover, unnecessary, and he proposed to substitute in those cases the term "semi-molecule," which was somewhat longer certainly, but otherwise preferable.

Dr. DEBUS then made some remarks in favour of the employment of the atomic theory, and said that, although it was not now the fashion to read the old standard works of the great masters in chemical science, he would like to go back some sixty or seventy years, to the year 1806 or 1807, when one of the greatest chemists, Berzelius, was engaged in the examination of salts, and found that when neutral salts decompose each other, the resulting salts were neutral: with regard to an explanation of this that chemist said he was in utter darkness until the intelligence reached him from England of Dalton's theory, which came upon him like a flood of light.

Dr. MILLS agreed with the author as to the possibility of doing without the atomic theory, but it had been considered a difficulty that if we discarded it we had nothing to put in its place. In the ordinary affairs of life, however, we acted differently; when anything bad came in our way we endeavoured to remove it without at all considering what we should put in its place. So with the atomic theory; it was much better in considering any reaction simply to look at the facts as they stood. Although what Dr. Debus had said about Berzelius was gratifying to our national feelings, it must be remembered that both Berzelius and Dalton were of a mechanical turn of mind, and that the great illumination which the former had received from Dalton's theory was not so much inherent in the theory itself, as an accident of Berzelius's mind.

Dr. GUTHRIE, after drawing attention to the resemblance in the manner in which the term atom was employed to that of the term catalytic force, referred to the use

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of the term dissociation, which he understood to mean that the atoms of some compounds in a vaporous state were supposed to be related in some way not absolutely in chemical union, and yet not disunited; this also strongly reminded him of the term catalytic action. Dr. Wright had said that one element could replace another, or was equivalent to it; now in a strict sense no case of this kind was known, as, if it were exactly equivalent, the compounds must be identical; metaphysically speaking, there was no real replacement in quantity as there was no real replacement in kind.

Dr. Wright, in reply, said that with respect to what Dr. Debus had said, he fully admitted that the atomic theory had been useful in illustrating facts, but at the same time was inclined to agree with Dr. Mills that the illumination which Berzelius received from it was due in great measure to the nature of that chemist's mind. For his own part he was disposed to regard its proper use as an algebraical expression of facts rather than as an hypothesis, and although he could not go so far as Dr. Mills in considering it a chemical evil, he had no doubt that a text-book could be written without the employment of the atomic theory. With regard to what Dr. Guthrie had said about replacement, he regarded chemical formulæ as expressions of facts, and not as indicating any particular theory of replacement.

When the vapour of any compound as NH_4Cl or H_2SO_4 in a state of dissociation was submitted to physical tests, such as diffusion, it was found not to be homogeneous; no doubt the term decomposition could be employed instead of dissociation to indicate this state.

Dr. Wright remarked further, in reply to an objection made by Dr. Guthrie that diffusion might itself decompose the vapours as it did in the case of the dialysis of certain salts, that in these salts the decomposition was caused by their solution, so that the phenomenon of diffusion was an effect and not the cause of their decomposition.

The President in his concluding remarks said that although it was comparatively easy to explain the fundamental facts of the science without the use of the atomic theory, when students had become more advanced they wanted some theory to classify and arrange those facts.

The meeting finally adjourned until Thursday, the 15th of February.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, January 23rd, 1872.

E. W. Binney, F.R.S., F.G.S., President, in the Chair.

The President exhibited to the meeting a large crystal of selenite, of an irregular form and 8 inches in length, given to him by Mr. Taylor, of Stretford. That gentleman informed him that it was from the mud which had been dredged out of the Suez Canal. When the mud came out of the dredge there was no appearance of crystals, but on its drying and being afterwards broken up they were found in the mass. The President said that he had noticed the formation of similar, but smaller, crystals of selenite in the clay taken out of the London and North Western Railway Tunnel during its formation through Primrose Hill. When the clay was first excavated there was no appearance of crystals in it, but after it had been exposed to the weather for a few months, on fracturing the clay these were found dispersed throughout its mass. He had also found crystals of selenite in the till or boulder clay at Egremont on the Mersey and at Blackpool; and the crystals, from their sharp edges, showed that they had been formed *in situ*, and had not come from a distance, as many of the stones in the deposit had undoubtedly done. He had also seen in coal mines the formation of small crystals of selenite nearly an inch long in a few weeks. In this case their formation was evidently due to water charged with carbonate of lime coming into the shaft from the overlying drift beds and finding its way down into the workings, and there mixing with water containing sulphate of iron derived from decomposed iron pyrites; the sulphuric acid of the iron going to the lime and forming sulphate of lime, whilst the carbonic acid once united to it went to the iron and formed carbonate of iron. He was not acquainted with the composition of the mud dredged out of the Suez Canal, and therefore could not speak with certainty, but probably the selenite was formed by a somewhat similar double decomposition to that last described.

Mr. Brockbank, F.G.S., exhibited a specimen of mineral wool, produced at the Conshohocken Iron Works, in America, by passing a steam jet through a stream of molten slag in its flow from the blast-furnace. It had a lustrous white fibre, singularly like cotton-wool from the pod. It can be made at a very trifling cost, and is likely to come into use for several purposes. It is said to be a very effectual non-conductor of heat, and this has led to its being used in the United States for the coating of steam-boilers and for the linings of refrigerators. Similar mineral wool is sometimes produced during the blowing in the Bessemer steel converters, but only in small quantities.

Mr. Brockbank also described a very simple mode of utilising slag, adopted at the George-Maria-Hütte Blast Furnaces, at Osnabrück, in Hanover. The molten slag is allowed to fall in a stream, from a height of about 8 feet, into water, and is thus formed into large bean-shaped gravel. From the water-tank it is lifted into railway-trucks by "Jacob's ladders," and is conveyed away as fast as it is produced, and largely used for metalling railways.

In some of the English iron works the slag is now being broken up by Blake's stone-breakers, and sold for metalling roads; and in this way it proves a source of profit, instead of being a considerable loss in its usual form of huge heaps of slag, disfiguring the country.

The Bessemer slags of the hæmatite furnaces are found to make excellent concrete, on account of the large quantity of lime they contain; they are also peculiarly suitable for manuring potatoes and barley, as they fall to powder under the action of the atmosphere and yield up their silica and lime to enrich the land.

CORRESPONDENCE.

A NEW ALKALIMETER.

To the Editor of the Chemical News.

Sir,—Having observed that all the alkalimeters in use are more or less defective, I have set myself to work to remedy their defects by inventing one which shall attain perfect accuracy.

Knowing the wide circulation of your valuable journal among scientific men, I venture to forward you a description and drawing. It consists of a glass cylinder, *a a*, 13 centimetres in length, similar to an ordinary glass syringe, divided into centimetres, and with an interior diameter of 75 m.m.

On the top of the cylinder is fitted a brass screw cap, in which works the piston rod, consisting of a screw, *r*, which extends its whole length, the pitch of which is two threads to the centimetre. The piston and rod are of brass; the former is platinised and surrounded by a fine india-rubber washer. The handle of the piston-rod is a drum, the circumference of which is divided into fifty parts. The instrument fits into a wooden stand similarly to Möhr's.

To use the alkalimeter immerse the inferior orifice, *b*, in the liquid, and screw up the piston until the required quantity is drawn up, then turn the instrument upside down, and turn the piston round once or twice, so as to

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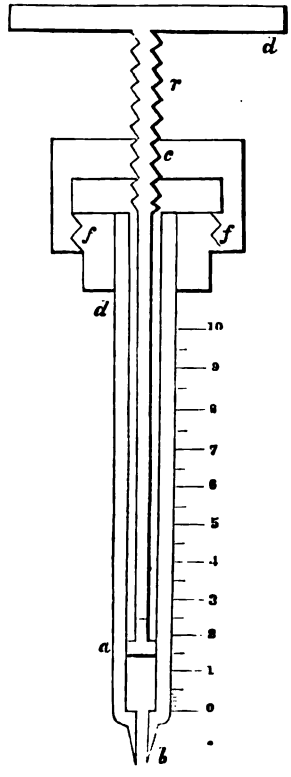
expel any air that may be between it and the liquid, then replace the instrument in its stand.

For every grm. required turn the piston round twice, and for every decigramme turn the drum round one-fifth of its circumference, and for every centigramme one-fiftieth.

The interior diameter of the tube being 0·75 centimetres will give an interior area of 1 square centimetre,



and, consequently, each length of a centimetre will contain 1 c.c. of water or a grm.; and as at each evolution of the piston it will descend 5 m.m. half a grm. will be expelled, and for every fifth of an evolution of the drum a decigramme, &c.

To clean the instrument, the cap unscrews at *f*.—I am, &c.,

CHIMISTE.

MISCELLANEOUS.

Fletcher's Gas Furnace and Hot-Blast Blowpipe.—The speciality of this furnace is the burner. It is as simple as an ordinary Bunsen's burner, but the flame is solid to the centre. Copper will fuse in any part of the flame; and to make a crucible furnace simply requires a support for the crucible, and a fire-clay jacket to prevent radiation. The lower part is a chamber 6 in. by 3 in., open at the bottom, in which the gas is partially mixed with air. This mixture is conducted to the top of the burner through a mass of fine tubes, with an arrangement to supply between each exactly the amount of air necessary to consume it instantly. A flame produced by this means, consuming 20 feet of gas per hour, is about 2 inches high and almost colourless. The whole of the available heat is generated below the object to be heated, which, therefore, is not also cooled by the passage of unburnt [illegible]. The point of greatest heat commences, as with a blowpipe, at the point of the blue cones, about ¼ in. or ⅜ in. above the tubes; and if the flame is protected with a ring of fire-clay, continues uniform for some inches above. The great heating power of the hot-blast blowpipe is obtained by an arrangement which enables both gas and air to be supplied to the jet at an exceedingly high temperature. The jet will fuse a strand of 6 or 8 fine platina wires into a bead with a small point of flame, and will give a small light with a cylinder of lime. With the gas fully turned on, it will melt 3 ozs. of 18-carat gold on pumice-stone. Steel wire burns readily, with brilliant scintillations, and wrought-iron wire is readily fused. The additional heating power may be used or not, at will, and the blowpipe can be used either with the mouth or a foot blower; when used with the mouth the head is not confined in one position, as in case of the old form, and both hands are at liberty. The extreme power is exerted to the best advantage on as small objects as possible, and when the gas is turned down to a blue cone of about 1 or 1½ inches long. The point of this blue cone will fuse a few grains of platinum, supported on lime, in five or six seconds, if a foot blower is used. If, however, a smaller quantity is taken—say half a grain—it is fused into a bead instantly, either with the mouth or a foot blower. If a platinum wire is used, it should be held with the point exactly in front of the point of the blue cone. With care, a bead may be fused on the end of a platinum wire almost as thick as ordinary copper bell wire. If a very fine wire is used, it will melt almost as quickly as it can be passed along the flame: in these experiments the eyes should be protected from the blinding glare of light, more especially in fusions on lime. For soldering and heating platinum crucibles, the gas should be turned full on, so as to produce a large rough flame, the heating power of which is about double that of the ordinary blowpipe. The lower burners need never be turned on more than is necessary to allow the flame just to reach the top of the coil. A trial of these apparatus in our laboratory has proved them to be most useful, but there is room for great improvement in the workmanship.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, January 2, 1871.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Electric Currents Obtained by the Bending of Metals.—P. Volpicelli.—The author first refers to the labours of Dr. Peltier on this subject, and, after relating at length his method of experimenting, summarises the results of his experiments in the following points:—All metals when being bent or twisted give rise to the development of an electric current, but copper exhibits this phenomenon in the highest degree. Lead, although not an elastic metal, also gives rise to the generation of an electric current, thus exhibiting an instance of the conversion of mechanical force into electricity; the electric currents thus produced are not perceptibly due to the development of heat due to the action of bending or twisting. When the bending is accompanied by the tearing asunder, or, rather, the distending, of the two ends of the metallic wire, a current is produced in an opposite direction from that obtained by putting the two ends nearer together; by increasing or decreasing the velocity of the bending, the intensity of the electric current is also increased or decreased. A metallic wire made of various metals soldered together produces, other conditions being the same, a less intense current by bending than when the wire is made of one and the same metal.

Condition of Substances when in Solution; Salts of Peroxide of Iron.—Dr. Berthelot.—The continuation of an exhaustive monograph on this subject. It appears that, when in solution, the peroxide

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of iron and the acids are united together only in a very loose manner, the decomposing action of the water becomes more conspicuous in the case of salts of the weaker acids—the ferric acetate, for instance; this decomposing effect increases with the larger proportion of the quantity of water, and also with elevation of temperature. It appears that, when once loosened from its union with acids, peroxide of iron assumes a peculiar molecular state, by which it is prevented entering again (while in solution) into union with the acid it has been combined to.

Spontaneous Decomposition of Divers Bisulphites.—C. Saint-Pierre.—Bisulphite of potassa, in concentrated or in weak solution, is spontaneously decomposed when exposed to a high temperature in closed vessels, giving rise to the formation of sulphur, sulphuric acid, and one or more of the acids of the thionic series. Sulphurous acid resists decomposition under the conditions alluded to; the bisulphites yield under the conditions just mentioned more sulphuric acid than can be saturated by the base present.

Researches on the Physiological Properties and Metamorphoses which Cyanates Undergo when Introduced into the Human System.—Drs. Rambuteau and Massul.—It appears from the authors' researches that alkaline cyanates when given internally become alkaline carbonates, as is the case also with acetates, lactates, and tartrates of potassa and soda; urea introduced into the stomach, or injected into the veins, is found again in the urine, while cyanate of ammonia, isomeric with urea, is converted into carbonate of ammonia.

January 8, 1872.

The following original papers and memoirs more particularly relating to chemistry are published in this number:—

Memoir on the Chemical Effects Due to the Calorific Action of Powerful Electric Discharges.—M. Becquerel.—After describing minutely and at length his apparatus and method of experimenting, the eminent *savant* states that the reduction of the oxides of silver, lead, tin, and copper is obtained by mixing these substances with some charcoal-dust, and exposing them to the heat derived from an electric discharge (powerful induction apparatus) in U-shaped tubes, while the oxides of nickel, cobalt, iron, and chromium, similarly mixed with charcoal-powder and some powdered sugar, and put into a platinum crucible, are also reduced; silica and alumina are fused, and sometimes small crystals are found in the fused mass.

Saccharine Substance Met with on a Lime-Tree (Tilia Europea).—Dr. Boussingault.—The author records in this lengthy memoir the results of his investigations on what is usually termed honey-dew—the appearance upon the leaves of certain trees of a kind of saccharine substance, which, curiously enough, was in this instance found to exhibit a very great similarity to the manna of Sinai and Kurdistan (formed, according to the researches of Ehrenberg and Hemprich, by the puncture of a kind of *Coccus* insect on the leaves of the *Tamaris mannifera*). The honey-dew *(miellée)* just alluded to was found to consist, in 100 parts, and collected at two different periods of time a fortnight distant from each other, of—(*a*). Cane sugar, 48·86; inverted sugar, 28·59; dextrin, 22·55. (*b*). Cane sugar, 55·44; inverted sugar, 24·75; dextrin, 19·81. Composition of the manna of Sinai, analysed by Dr. Berthelot—Cane sugar, 55 per cent; inverted sugar, 25; dextrin, 20; total, 100. For an equal square surface the quantity of honey-dew on the unhealthy leaves of the tree was far larger than that contained on the healthy leaves.

Relation Existing between Capillary Action and the Density (Specific Gravity) of Saline Solutions.—C. A. Valson.

Action of Heat upon Oxychlorides of Silicium.—L. Troost and P. Hautefeuille.—The authors record at great length the results of a series of experiments made with the oxychloride, $Si_2O_2Cl_6$. The chief point of interest is that the compound alluded to is partly decomposed when submitted to the action of heat, giving rise to the formation of more oxygenated and more condensed oxychlorides, while a portion also of the original compound is regenerated.

Action of Iodide of Lead upon some Metallic Acetates.—D. Tommasi.—The acetates can be, in this respect, divided into three groups, viz.—Acetates which combine with iodide of lead; only the acetate of potassium does this. Acetates which, while reacting upon the iodide, give rise to the phenomenon of double decomposition; the acetates of copper and mercury. Acetates which act upon the iodide of lead simply as solvents; such as the acetates of sodium, ammonium, lithium, calcium, barium, magnesium, zinc, manganese, chromium, iron, cobalt, aluminium, and uranium.

Chemical Investigation of a Complex Alum Obtained from the Thermo-Mineral Water of the Solfatara of Pouzzoles (near Naples).—S. de Luca.—After first referring to researches made on this subject more than a year ago, the author states that by the slow and spontaneous evaporation of the water just alluded to (it contains free sulphuric acid) there is formed a complex alum, which crystallographically corresponds to this well-known salt in every respect; sp. gr. at 17° = 1·774; it consists, in 100 parts, of—Sulphuric acid, 36·74; alumina, 6·70; ammonia, 10·82; peroxide of iron, 0·97; protoxide of iron, 1·10; lime, 0·65; magnesia, 0·30; potassa, 0·17; water, 40·98; soda, manganese, and loss, 1·57. The quantity of sulphuric acid suffices to saturate the bases present as protoxides, as well as the sesqui-oxides of iron and aluminium, thus constituting several sulphates, which, by their union, form a complex alum.

Although not belonging to the subjects usually treated of in this periodical, we call attention to the following work:—

L'Administration Militaire dans l'Antiquité.—M. Gauldrée-Boileau.—The eminent *savant* M. J. Dumas, as Perpetual Secretary of the French Academy of Sciences, calls special attention to this volume (presented by its author to the Academy), a work treating minutely and *with very great precision* on the military matters of the Romans and Greeks, the conclusion being that even in our days we may learn from the ancients.

Annalen der Physik und Chemie, von Dr. J. C. Poggendorff, No. 11, 1871.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Law of the Formation of the Lichtenberg Figures.—W. von Bezold.—An exhaustive memoir, illustrated by a series of engravings.

Continuation of the Essay on the Influence of Astronomical Motions on Optical Phenomena.—E. Ketteler.

Mineralogical Communications.—G. vom Rath.—This portion of this lengthy memoir contains the following sections:—On the chemical composition of some varieties of orthoclase; on the erbsite of Pargas; on the occurrence of sahlite (lime-magnesia-iron-augit) in the Pennine Alps; interesting excrescence of wollastonite from Monte-Somma; on allophan from Dehrn, near Limburg, in Nassau. This essay is to be continued; its contents, although interesting in a scientific point of view, are not well suited for useful abstraction.

Alleged Presence of Vesicles of Vapour in the Atmosphere.—J. Kober.—The author reviews in this essay the value of the opinions of a large number of *savants* belonging to various countries on the subject mentioned, and next quotes experiments from which he comes to the conclusion that the arguments brought forward to sustain the view of the presence of vesicles of aqueous vapour in our atmosphere do not hold good. The watery vapour present in the atmosphere consists of larger or smaller solid drops *(soliden tröpfchen)*; the drops of water floating about in the atmosphere become covered with a more or less thick layer of air; these drops so enveloped with air often form conglomerations. The falling downwards of these drops of fluid is not only prevented by ascending currents of air, but also by adhesive force.

Elementary Derivation of the Fundamental Equation of the Dynamical Theory of the Gases.—Dr. L. Pfaundler.—A mathematico-physical memoir.

Remarkable Observation Made with the Gold-Leaf Electrometer.—Dr. A. Forster.—The contents of this paper are, notwithstanding its intrinsic value, not suited for useful abstraction, an observation also relating to the following essays:—

Action of Electricity upon Liquids.—W. Beetz.

Spectroscopical Observation of the Sun's Rotation, and on a Newly-Arranged Reversion Spectroscope.—F. Zöllner.

Two New Methods of the Measurement of the Height of the Clouds.—Dr. Feussner.

Simple Thermo-Regulator.—E. Reichert.—Illustrated by engravings. An excellent contrivance for keeping up with either gas or petroleum-oil lamp a constant temperature for any length of time.

Sound of the Tingling in the Ears.—J. J. Oppel.

Extraordinary Formation of Ozone.—Dr. Pincus.—The author states that, if perfectly pure dried hydrogen gas is caused to burn in a very small flame from a jet ending in a very fine point, the smell of ozone is very distinctly perceived, and it becomes more conspicuous if a dry and clean beaker-glass is held over the flame. When, by the aid of a properly contrived apparatus, the combustion takes place in pure oxygen, the same phenomenon is observed.

Journal für Gasbeleuchtung und Wasserversorgung, No. 23, 1871.

The contents of this number relate strictly to matters belonging to gas- and water-works' engineering and management. We notice, however, that the oxyhydrogen method of gas-lighting of Tessié du Motay has been introduced for the lighting of the extensive railway-station of the Empress Elizabeth line of railway at Vienna, and that the process far exceeds the expectation of all who have witnessed its application there.

No. 24, 1871.

The original papers contained in this number bear strictly upon matters connected with gas- and water-works.

Bayerisches Industrie und Gewerbe Blatt, January, 1872.

This number, which opens with a short notice intimating that the November and December numbers of last year are yet in the press, contains the following original papers and memoirs relating to chemistry and allied subjects:—

Notice on a Pavement Made of Compressed Asphalte at Munich.—A. Zenetti.—This paper contains an excellent historico-technical account on the subject of asphalte pavements in general.

Estimation of the Hardness of Water for Technical and Scientific Purposes.—A. Wagner.—The greater portion of this lengthy memoir treats on the faults and difficulty of proper manipulation of the Clarke-Wilson soap test, and on the influence of the presence of magnesia salts in water as affecting the results of hardness obtained by this mode of testing. In the next place, the author states that for the knowledge of the quality of any kind of water it is only necessary first to estimate, by a carefully-made evaporation of a certain bulk of water (100 c.c. for very hard, and up to 500 c.c. for very soft), the total quantity of saline constituents, and next to ascertain the quantity of saline matter soluble in water present therein. It is further stated that the error due to the decomposition of chloride of magnesium and organic matter is so small as not to affect the general result, especially for technical purposes.

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Lightning and Lightning-Rods and Conductors.—M. Landsberg.—This exhaustive essay, illustrated by a series of woodcuts, contains a very excellent review of all matters, scientific as well as practical, belonging to this subject.

Description of an Apparatus for Boiling Linseed Oil, Arranged to Render Innocuous the Pungent Vapours Evolved.—Dr. G. Feichtinger.—Illustrated by a woodcut.

Dinas Fire-Bricks; Quartz Bricks.—Dr. Bischof.—The author treats on the mode of manufacture of a peculiar kind of fire-brick made near Neath, in Wales, from a raw material locally known as the Dinas sandstone.

Noxious Effects of the Tar Colours on the Human Organism.—W. Mayer.—The author states that, as regards the aniline colours, if pure and properly made they are not poisonous, but that, in consequence of imperfections in the preparation, these pigments often contain arsenic and picric acid, to which is due the poisonous action of these substances, while, as regards the phenol pigments (rosolic acid [aurin], corallin, and azulin) they are seldom, if ever, quite free from phenol, and hence poisonous.

Utilisation of Tin Scraps.—A. Ott.—This essay contains an exhaustive review of all that has been preposed and practically done for the purpose of utilising the tin and sheet-iron of which the tin scraps are composed.

Bibliography.—Under this heading we call attention to the following work:—"Technologische Wandtafeln herausgegeben," von Dr. Friedrich Knapp, Bestehend aus 64 Colorirten Blättern Grösztentheils Formates und Ebenso Vielen Textblättern. This collection of 64 coloured plates, each 4 ft. 8 in. high by 3 ft. 8 in. wide, contains the carefully executed drawings of the best and most recent apparatus and machinery used in all branches of industry. The plates are sold varnished and ready for use in colleges and schools; the entire collection, with descriptive text, is sold at £6 10s.

Zeitschrift für Chemie von Beilstein, No. 15, 1871.

The following original papers and memoirs are contained in this number:—

Bromated Benzol-Sulpho Acid.—R. Fittig.—The author first reviews the labours of A. R. Garrick on this subject published in this periodical some years ago. It appears that the author prepared a large quantity of iso-brom-benzol-sulpho acid, the potassa salt of which, having been fused with excess of caustic potassa, yielded, after treatment with water and purification, pure resorcin, thus leading to the same result as that obtained by the chemist above named; it was further ascertained that hydrochinon is also formed.

Dinitro-Phenols.—W. Schneider.—While nitrating mono-nitro-phenol according to Körner's process, the author observed the formation of two isomeric dinitro-phenols, one of which is identical with the dinitro-phenol obtained from ortho-nitro-phenol; the other is isomeric therewith, fuses at from 61° to 62°, is soluble in water, crystallises on evaporation of the solvent, and is readily soluble in alcohol and ether. The salts of this dinitro-phenol are distinguished from those of the other dinitro-phenol by a different degree of solubility, and the baryta salt of the dinitro-phenol fusing at between 61° and 62° is especially different by its greater insolubility in cold water; the salt crystallises in bright yellow-coloured crystals; formula, $(C_6H_2(NO_2)_2O)_2Ba+H_2O$. The formula of the dinitro-phenol alluded to is $C_6H_2(NO_2)_2NH$.

Nature of the Coal-Tar Oil Products Boiling between 161° and 169°.—P. Jannasch.—When coal-tar oil of high boiling-point is first treated with hot and concentrated caustic soda ley for the purpose of eliminating carbolic acid, and next rectified over sodium, the result is that there are obtained two substances, one of which boils at between 161° and 165°, and the other at between 165° and 169°; these products (not further specified) yield, on being treated with bromine, large crystals fusing at between 86° and 87°, but become decomposed at a higher temperature, and even cannot bear boiling with alcohol. By elementary analysis of this body, results were obtained leading to the formula $C_6H_6Br_2O$. Treated with nitric acid, these crystals yield picric acid; treated with sodium amalgam, they yield a solid crystalline mono-bromated product, boiling at from 212° to 216°, fusing at between 38° and 39°, and very soluble in ether, benzol, chloroform, and alcohol.

Dibromo-Pseudo-Cumol.—P. Jannasch and H. Süssenguth.—The authors obtained by the bromising of coal-tar oil, pseudo-cumol among other substances, a crystalline body, sparingly soluble in cold alcohol, more readily so in that liquid when hot, and very readily soluble in ether, benzol, and chloroform; formula, $C_9H_{10}Br_2$; point of fusion, 63° to 64°; boiling-point, 277° to 278°.

The American Journal of Science and Arts, January, 1872.

In addition to several important papers relating to geology, mineralogy, astronomy, and natural history, this number contains the following papers relating to chemistry:—

Relative Proportion of Iron and Sulphur in the Pyrites Contained in Several Specimens of Iowa Coal.—R. Emery.—This investigation was undertaken with the view to ascertain the correctness of the statement made by Prof. Wormley, who, on analysing the Ohio coal, found an amount of sulphur too large for combination with iron as FeS_2. The results of this research of the Iowa coal (ten samples) are that in four of these samples the quantity of sulphur corresponded to that of the formula FeS_2, in four other samples a marked excess of sulphur was found, while in two of the samples S was [illegible] with Fe the compound FeS_2.

Occurrence in Nature of Amorphous Mercuric Sulphide.—Dr. G. E. Moore.—This essay contains the very minute and extensive description of a peculiar mercury ore met with in California, which on analysis was found to consist, in 100 parts, of—HgS, 98·92; FeS_2, 0·83; quartz, 0·25.

Composition of the Labradorite Rocks of Waterville, New Hampshire.—E. S. Dana.—The detailed account of the mineralogical characters and chemical composition of some rocks and minerals of the locality alluded to.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, December 28, 1871.

This number does not contain any original papers relating to chemistry, but we notice a short paper:—

Consumption of Horse-Flesh in Paris.—Dr. Decroix.—From the contents of this paper it appears that since July 9, 1866, when the sale of horse-flesh was first commenced under proper sanitary supervision, up to the present day, the consumption of this meat as human food has steadily increased, 70,000 horses having been consumed during the late siege in Paris alone. The author estimates that annually 200,000 horses can be readily supplied for consumption of meat in France, and, taking the average weight of meat suitable for consumption of each horse at 200 kilos., this will yield 40,000,000 kilos. of horse-flesh for consumption.

Bibliography.—Under this heading is published here a review of the work—"Cours Elémentaire," par M. Stanislas Meunier, Dunod, Editeur, 49, Quai des Augustins, à Paris. The author of this work is well and deservedly known as a very emiment geologist in France as well as abroad; this work is highly spoken of by the reviewer, Dr. F. Hamel, who states that the author's aim to produce a really practical and lucidly written work on this subject has been thoroughly accomplished in the compact space of 460 pages.

NOTES AND QUERIES.

Ulex's Test.—Will any of your readers have the goodness to inform "Silex" what is "Ulex's test" as applied to kainit or crude potash salts in estimating the sulphate of potash.

Organic Chemistry—Dialysis—Hydrogen Musical Flame.—Is there any book on Organic Chemistry which you could recommend for students in which is to be found an orderly division of the matter, and someting like a philosophical arrangement of principles? The frequent omission of Organic Chemistry in the text-books for beginners makes me fear that there is a general feeling of the matter being too difficult for such students; still, would it not be possible to give them some outline of principles? What is the received opinion in England of "dialysis," "diffusion," "osmose;" are they one and the same thing, or not? I perceive that the French authorities hold that they are all three the same, at least in principle. Graham's notions of colloid and crystalloid are not received at all. A curious phenomenon showed itself during class this morning: a hydrogen flame sounded steadily, without any tube surrounding it. The source of the sound seemed to be in the hydrogen bottle; it could be heard from the gas-leading tube, when this was removed from the jet. The flame increased the strength, but did not change the tone.—E. KERNAN, Clongowes.

MEETINGS FOR THE WEEK.

MONDAY, Feb. 12th.—Medical, 8.
—— Royal Geographical, 8.30.
—— London Institution, 4. Prof. Odling, F.R.S., on "Elementary Chemistry."
TUESDAY, 13th.—Royal Institution, 3. Dr. W. Rutherford, F.R.S.E., "On the Circulatory and Nervous Systems."
—— Civil Engineers, 8.
—— Photographic, 8. Anniversary.
WEDNESDAY, 14th.—Society of Arts, 8.
—— London Institution, 6.30. Conversazione. Lecture on "The Sun," by Mr. Norman Lockyer, F.R.S.
THURSDAY, 15th.—Royal, 8.30.
—— Royal Society Club, 6.
—— Chemical, 8.
—— Royal Institution, 3. Prof. Odling, F.R.S., "On the Chemistry of Alkalies and Alkali Manufacture."
FRIDAY, 16th.—Royal Institution, 9. Dr. Gladstone, F.R.S, "On the Crystallisation of Silver and other Metals."
SATURDAY, 17th.—Royal Institution, 3. Wm. B. Donne, "On the Theatre in Shakespeare's Time."

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THE CHEMICAL NEWS.

VOL. XXV. No. 638.

A STUDY OF CERTAIN TUNGSTEN COMPOUNDS.*

By Professor HENRY E. ROSCOE, Ph.D., F.R.S., &c.

(Concluded from p. 63.)

Bromides of Tungsten.

BROMINE vapour acts rapidly on hot metallic tungsten, forming dark bromine-like vapours which condense to a crystalline sublimate. Especial precautions require to be employed as regards exclusion of oxygen and moisture, as the oxybromide formed when these substances are present possesses very nearly the same colour as the bromide, and cannot be easily separated from the latter.

Tungsten Pentabromide, WBr_5.—By the action of excess of bromine on tungsten a penta- and not a hexa-bromide is obtained. Prepared in this way, the pentabromide forms dark shining crystals having a metallic lustre not unlike that of iodine. These crystals melt at 276° and solidify at 273°, the liquid boiling at 333° (corr.). The pentabromide is at once decomposed by excess of water into the blue oxide of tungsten and hydrobromic acid, and immediately undergoes the same decomposition on exposure to moist air. On distillation, a small quantity of a lower non-volatile bromide remains behind, and this explains the slightly too high percentage of metal found in the analysis.

		Calculated.	Found.
Tungsten	W = 184	31·51	32·49
Bromine	Br_5 = 400	68·49	67·74
	584	100·00	100·23

When the pentabromide is heated to 350° in a current of hydrogen, a substance is obtained which appears to correspond to WBr_3, but this is very readily decomposed, and the dibromide, WBr_2, is formed as a black velvety powder. Analysis gave—

		Calculated.	Found.
Tungsten.. ..	W = 184	53·49	52·03
Bromine	Br_2 = 160	46·51	46·26
	344	100·00	99·29

Oxybromides of Tungsten.—The monoxybromide, $WOBr_4$, is formed, together with the dioxybromide, $WOBr_2$, by acting on a mixture of 1 part of metal and 2 parts of tungsten dioxide with bromine. It forms shining brownish black needles, which are easily fusible, and can be separated from the dioxybromide by gentle sublimation, when the latter compound remains behind. The monoxybromide melts at 277° and boils at 327·5°, and is readily acted on by water.

The mean of four analyses gives—

		Calculated.	Found.
Tungsten	W = 184	35·38	36·69
Bromine	Br_4 = 320	61·54	61·04
Oxygen	O = 16	3·08	
	520	100·00	

The dioxybromide, WO_2Br_2, is formed as light reddish brown vapours, which condense to reddish-brown coloured crystals by passing the vapour of the pentabromide over tungsten trioxide. The crystals do not melt, but volatilise at a temperature near to a red heat, and they are not acted on by water.

Analysis of four samples gave—

		Calculated.	Found.
Tungsten	W = 184	48·94	49·18
Bromine	Br_2 = 160	42·55	42·05
Oxygen	O_2 = 32	8·51	
	376	100·00	

Iodide of Tungsten, WI_2.

On passing iodine vapour, together with carbonic acid, over metallic tungsten heated to redness, a very small quantity of soft scaly crystals having a greenish metallic lustre is found to sublime. The same substance is formed (but also in small quantities) when iodine vapour is passed over the heated brown oxide or a mixture of metal and oxide. The product was analysed by passing air over the heated iodide, when it is readily converted into tungstic acid, iodine being liberated. The iodide is infusible and cannot be re-distilled without decomposition, and it is not immediately acted on by water.

Analysis gave—

		Calculated.	Found.
Tungsten	W = 184	42·01	42·95
Iodine..	I_2 = 254	57·99	56·64
	438	100·00	99·59

Atomic Weight of Tungsten.

1. *By Reduction of Tungsten Trioxide.*—The difficulty of obtaining perfectly pure tungstic acid and the effect which impurity produces on the atomic weight determinations has been pointed out by Dumas. In order to avoid the danger to which all the former determinations are subject, consequent upon the partial reduction of the acid to green oxide which cannot again be oxidised, and the production of which seems to be caused by presence of traces of alkali, the tungstic acid used was prepared by decomposing oxychloride with water and drying and igniting in platinum (contact with glass reduces some WO_3). The loss of weight on reduction in hydrogen and gain of weight on oxidation was several times repeated. The oxide was placed in a porcelain boat, being heated in a porcelain tube, and reduced in hydrogen and oxidised in a current of air. After each reduction the boat was found to be partially coated inside with a thin black film having a metallic appearance which oxidised completely when heated in air. A second boat was placed in the tube beyond that containing the substance for the purpose of ascertaining whether any metal was volatilised, but this boat was not found to become the least discoloured. The results of the determinations were as follows:—

	Grms.
1. Original weight of oxide	7·8840
2. Oxide after 1st oxidation	7·8806
3. ,, 2nd ,, ...	7·8792
4. Weight of metal, 1st reduction..	6·2438
5. ,, ,, 2nd ,, ..	6·2481
6. ,, ,, 3rd ,, ..	6·2488

It is evident from these numbers that the 2nd and 3rd weights of oxide and the 2nd and 3rd weights of metal are the only ones which can be relied on as being perfectly pure. Taking the mean of these two series, we have 7·8799 grms. of oxide, giving 6·24845 grms. of metal, or 79·296 per cent. This corresponds to the atomic weight 183·84. In order to have obtained the number 184·00, the weight 7·8799 grms. of oxide must have yielded 6·24960 grms. of metal, differing by 0·00115 grms. from the experimental number.

2. *By Analysis of the Hexachloride.*—Perfectly pure hexachloride was prepared from the pure metal (itself obtained from oxychloride). No traces of oxychloride could be detected in the hexachloride employed, and it yielded a perfectly canary-yellow trioxide on treatment with water, showing absence of any pentachloride. In the determination of the chlorine, the substance was weighed in the piece of drawn-out combustion tubing, in which it

* Read before the Manchester Literary and Philosophical Society, January 23, 1872.

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was afterwards reduced in hydrogen, the hydrochloric acid being collected and estimated as silver salt. The determination of metal was made in a porcelain boat in which the weighed hexachloride was first carefully converted into trioxide by exposure for two days to a moist atmosphere, and afterwards reduced in hydrogen. Analysis gave—

	Grms.
(1). Weight of tungsten hexachloride taken	19·5700
,, chlorine found	10·4901
Percentage of chlorine	53·6050
(2). Weight of chloride taken	10·4326
,, metal obtained	4·83740
Percentage of metal	46·3680

Hence the atomic weight of the metal is 184·25; or, taking the mean of the two methods, we have 184·04 as the atomic weight of tungsten.

The author wishes to express his thanks to Mr. H. Rocholl, who has ably aided him in the above research.

RELATIONS BETWEEN THE ATOMIC HYPOTHESIS AND DISSECTED FORMULÆ.

By C. R. A. WRIGHT, D.Sc.,
Lecturer on Chemistry at St. Mary's Hospital.

To prevent misconceptions, permit me to supplement by some explanatory remarks the accurate, though necessarily brief, report of my paper on the "Relations between the Atomic Hypothesis and the Condensed Symbolic Expressions of Chemical Facts and Changes known as Dissected (Structural) Formulæ."

The propositions promulgated by Dalton are separable into two entirely distinct portions, viz., the *generalisation* that the quantitative compositions of compounds are expressible by assuming certain numerical values for each element, and taking simple integral multiples of these values to indicate the relative proportions in which the respective elements co-exist in given compounds (*e.g.*, assuming for carbon, oxygen, and hydrogen the respective numbers 6, 8, and 1, the composition of ethylene is expressed by 6 parts of carbon to 1 of hydrogen, and of marsh-gas 6 to 2×1 of hydrogen, of carbon oxide, 6 of carbon to 8 of oxygen, and of carbonic anhydride 6 to 2×8 of oxygen, and so on), and the *hypothesis* which furnishes a *raison d'etre* for this observed fact, viz., that elements are made up of atoms of the relative weights denoted by these numbers, compounds being aggregations of molecules each of which consist of small numbers of each component kind of atom; 1 to 1, 1 to 2, 2 to 3, &c., respectively.

Although Dalton himself and many subsequent chemists may not have clearly discriminated between these two ideas, and may have regarded them as inseparably connected, yet the writings of chemists contemporaneous with that illustrious man clearly show that even in his day the distinction between the two notions was clearly made; thus Sir H. Davy rejected the hypothesis although he admitted the generalisation.* It is by no means clear that the "flood of light" which was let in on the mind of Berzelius on first hearing of Dalton's views was caused by the *hypothesis*; the *generalisation* affording, as it did, the means of readily expressing in brief the complicated and apparently unconnected *percentage compositions* of different compounds previously in use, necessarily produced such simplifications as to render the hypothesis, which so elegantly accounted for the facts, doubly attractive; nevertheless, the hypothesis was not universally accepted though the generalisation was beyond contradiction.

In the paper I have endeavoured to separate, as far as possible, the facts known to Dalton and discovered since his day, with the extensions of his generalisation (only applied gravimetrically by him) and other facts indicated by the symbolic system, the first germs of which (as a means of representing many facts in brief) he furnished, from the hypothesis which he laid down to account for certain of these facts and the subordinate hypotheses and postulates since added to it; and so far from agreeing that the *hypothesis per se* has been the main cause of the rapid advances in chemical knowledge made since its promulgation, I am inclined to the opinion that the progress is almost wholly attributed to the *generalisation and the consequent establishment of symbolic representations of chemical facts*, which give to the intellect of the chemist an aid analogous to that which algebraic symbols render to the mathematician. The reason why the atomic hypothesis has been credited with being the source of such advantages is that fundamental facts, by reasoning on which the advances have been made, have been usually expressed in the language of the hypothesis; but so far as the hypothesis is concerned, this is a mere accident, for it can hardly be doubted that the same conclusions would have resulted had the fundamental facts been expressed in other phraseology. In working out a mathematical problem the calculator does not mentally go through every link in the long chain of reasoning whereby every proposition may be proved from fundamental postulates; he simply employs condensed symbols which refer to and involve these propositions: so the chemist in reasoning on the interpretation of new facts does not perpetually go back to his conceptions as to the ultimate nature of matter; he only applies to the particular case certain generalisations drawn from past observations of facts, and summarised in symbolic forms.

The conception of material atoms associated with one another in different numbers, orders, and positions may, to some minds, appear a more satisfactory method of colligating facts than a system which simply uses certain conventional symbols to indicate these facts: so some minds are unable to grasp the notion that, for example, 6 and 8 are 14, without going through the mechanical process of counting on the fingers, &c., and to some the Euclidean demonstration that the cubic content of a cone is one-third that of the cylinder of the same altitude and on the same base, does not give any clear idea, whereas an experimental demonstration with water and cylindrical and conical vessels carries immediate conviction. That such mechanical notions are of a lower intellectual order than the abstract notions of numbers and their mutual relations requires no further illustration than the history of the terms *calculation* and *calculus*, which though now used in reference to purely intellectual processes of the highest order (aided by symbolic expressions) originally referred to the employment by barbarous notions of *calculi* or pebbles for the purpose of enumeration.

Admitting that the atomic hypothesis has directly on its own account, or indirectly by furnishing succinct and comprehensive language to express facts, done great service in the development of our present symbolic system and in the acquisition of knowledge, and that it affords a satisfactory explanation of several cardinal facts, and is in harmony with many physical generalisations (which is about the sum of what may be said in its favour), still these circumstances remain, that it is a mechanical conception suited, doubtlessly, to an age when an accurate knowledge of facts was only first beginning to exist, these facts being of a nature difficult to grasp without some material aid, but not possessed of such advantages when the knowledge of these facts and their correlations becomes somewhat more extended; that it is unnecessary to express any facts, and incompetent (without much patching and botching) to explain many generalisations, where the measurement of force of some kind is a necessary datum; hence the conclusion is drawn that it is undesirable

* The distinction is clearly made in a "Chemical Catechism," by Thomas John Graham, M.D., second edition, 1829, this book being used as a text-book by students of that period in the Universities of *Glasgow* and Edinburgh.

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that the ideas and language of this hypothesis should occupy the prominent and fundamental part in chemical philosophy now attributed to them.

Chemical Laboratory, St. Mary's Hospital,
February 10, 1872.

ON THE "CARBON CLOSET SYSTEM."*

By E. C. C. STANFORD, F.C.S.

I AM induced to bring this subject specially before this Section because I consider its merits have never been properly brought under your notice and fully discussed. It has been so fashionable to consider the water-closet system as the perfection of sanitary skill, particularly among engineers, who generally look upon it as the *only feasible* means of house excreta removal, that it requires some hardihood for a chemist to urge here a totally opposite opinion. The fact is, however, that by putting this noxious and yet valuable material in the sewers the engineers have removed it from the power of the chemist to bring his science to bear on it. All proposals to deal chemically with the enormous dilution of town sewage have hitherto failed; nor, as far as we know, is there the least probability that anything effectual or profitable can be done in this direction.

Now I have always held that if we are to do anything to assist sanitary science we must begin with the noxious material at an earlier stage of excreta removal than as town sewage. Moreover, I consider that the system by water carriage is founded on error. To accomplish the required result an enormous proportion of water is necessary; no doubt it was at first supposed that this large proportion of water would oxidise and render innoxious the poisonous matter, but the contrary is now admitted to be the case—decomposition is rapidly increased and promoted. Moreover, the poison germs, so far from being destroyed, are diffused broadcast with appalling rapidity. In times of danger this becomes painfully evident; hence the *Times*, in a recent article on the expected cholera epidemic, raises an alarm in the following terms:—

"In the first place, the destruction of the excreta from cholera patients must be insisted on under the heaviest penalties, and a system of inspection adequate to enforce this provision must be organised. Without these preliminary safeguards we cannot hope to resist the enemy with any success. So long as the germs of the disease are allowed to pass through the sewers into the rivers, to be washed up by the tide against our seaside villages, to be wafted about our streets in the form of an impalpable dust, we cannot hope for any good results from sanitary measures of the ordinary kind. Cleanliness, ventilation—above all a pure water supply, are advantages which cannot be over valued. But until the germs of disease are systematically destroyed and excluded from any chance of mingling with the air we breathe and the water we drink, nothing will control the ravages of cholera. Every other precaution is subordinate to the main preventive measure, which it will need special powers to carry into effect—the destruction of the cholera germs before their diffusion."

The "sanitary deadlock" is sufficiently perplexing without this further complication; one authority obliging the distracted members of town councils to drain *somewhere*, another interdicting the drains from flowing almost *anywhere*; but none telling them *where* or *how* to dispose of their refuse. Now, however, the sewage question is to undergo another complication. The citizens of London, after paying so very handsomely for their grand experiment on main drainage, are to be told that, just when they most require it to purge their houses of poison and pollution, the mighty engine has broken down, and they must fall back on their own resources.

There can be no doubt the *Times* is quite right: the prohibition is absolutely necessary if the plague is to be stayed; but admit this, and the water-carriage system goes by the board, it must be condemned as unable to cope with the removal *under all circumstances* of house excreta.

In Glasgow, the Sanitary Section of the Philosophical Society, after two years' discussion, on which most of the members entered with strongly preconceived prejudices in favour of water carriage, a unanimous resolution was passed strongly condemning it, and insisting that in the perfect system of the future all fœcal matters must be rigidly kept out of the public sewers.

It is a compliment to the intelligence of that resolution to find that public opinion is gradually working round in the same direction. The city of Glasgow may not have been so far wrong after all in watching and waiting the experience of the great city before committing herself to a proportionately costly scheme. At the time the resolution I refer to was passed, the water-closet at one end and irrigation at the other were generally considered the two *necessaries* to all civilisation. We have lived to see that neither of these are necessaries, and that neither are generally applicable or advantageous. We are told now that successful irrigation must be accompanied by processes of deposition or filtration. The British Association Committee even recommend two separate systems of drainage, and this partly concedes what the resolution referred to demands. I would, however, go further, and treat the house excreta as a material the removal of which should have no connection whatever with the sewers and should never be mixed with water; in fact, that the sewage system should not be complicated by this, the main source of the worst pollution.

Now I affirm that in the most populous cities the general use of the carbon closet system is perfectly practicable, and that it must be by far the most healthful and by far the most profitable means of getting rid of the nuisance.

In this Section last year I heard a gentleman say that "no scavenger should ever visit his house." Now I should like to have asked how that gentleman disposed of his house ashes, because either he allowed the scavenger to call for them, which disproved his assertion, or he put these into the sewers, in which case some other local authority ought to look after him. This, however, is not an uncommon feeling of repugnance on the part of the householder, and must be duly respected; yet the most prominent advocate of water carriage must draw the sewage line somewhere, and all would draw it outside of house ashes. These must not in any case find their way into the sewers. But in the more noxious and more valuable material we actually have much less to remove, and the removal can be made equally inoffensive. I admit that any system to be generally adopted must require no attention from within and must be quite as automatic as the water-closet. This, however, is easily arranged, and if one tithe of the talent and ingenuity had been spent on the dry system that has been lavished on the wet, it would, I believe, have long ago superseded it in this country. There is no more necessity for a scavenger to enter a house properly arranged on the dry system than on the other.

Let us consider, in the first place, what is the actual total amount of excreta per head to remove; and I wish to premise that I would advocate no system that was not intended to cope with the whole of the house excreta, solid and liquid, leaving only the wash-waters to enter the ordinary drains.

I have published a table, taken from various authorities, showing the estimated amount of this material to be removed per head, with its value.* The last table are

* Read before the Mechanical Section of the British Association at Edinburgh Meeting.

* CHEMICAL NEWS vol. xxii., p. 302.

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the figures employed by Her Majesty's Commissioners on the Pollution of Rivers in their reports, and as they make no allowance for loss, for absence from home, &c., I think the average of 8 cwts. (including only about ¾ cwt. solid excreta) per head may be fairly taken; so that in a large household of ten persons it would amount to 80 cwts. (about 8 cwts. solid), and its chemical value would be about 80s., or 8s. per head. The same household would use at least 20 tons of coals, and probably send away 4 tons of ashes. The total annual quantity of charcoal required therefore could not exceed 4 tons, would probably be much less, and the whole removal, allowing for the drying action of the charcoal in the vault, would be about 5 to 6 tons weight.

Eight cwts., then, is the total quantity to be annually removed per head, and it is now generally effected by mixing it with about 1200 tons of pure water, all of which it renders highly offensive, and its value, however it may be extracted, if that be indeed possible, is reduced to very much less than this, over and above the dilution, in inverse proportion.

It is scarcely necessary to reiterate the disadvantages of this method of removal. We know that the closets are costly in erection and in repairs, that they consume and foul a large portion of our water supply, and that they have hitherto wasted the whole of the material. We first tried to confine the polluted water in cesspools, then we converted these into a network of deep laid sewers, thereby connecting all the houses and insuring the spread of a cholera or typhoid fever epidemic. We do not know yet how to deal with the sewer gases, and have discovered no certainly perfect method of getting rid of the pollution. Now it does appear to me that we have mistaken the application of water; we do not require such a gigantic carrier and diffuser. Knowing how possibly dangerous the excreta may become, we ought to seek a disinfectant which will add as little as possible to its bulk and increase its manurial value. Therefore I would at once add that precisely the same objection may be urged against the use of earth, which would require three and a half to four times the quantity of the material removed, and reduce the value of the manure to even less than this in inverse proportion. The analyses of earth-closet soil by Dr. Gilbert confirm my views as to the poverty of the manure. The same applies more forcibly to the use of ashes, of which even more are required. These two materials act only as deodorisers so long as they are dryers; let the mixture become damp, and it at once becomes offensive. The use of earth in large cities must be impracticable and will always be expensive. Ashes can generally be provided in the house, but these are not so good as earth, and the manure is scarcely worth removing. In all the towns referred to in the British Association Committee's reports where this system is adopted the price obtained is merely nominal.

In discussing the merits of a dry system, we have always this advantage over the advocates of the wet system, that, while they are limited to the use of water, we have a large choice of dry deodorisers. That which promises the greatest success is charcoal, and this is now being made the subject of experiment on a pretty large scale. There is no greater difficulty than to provide closets for workmen which shall always be perfectly inoffensive and shall not get out of order. I can point out one work where the system I advocate has been in use for three years by 150 men, and the closets have never got out of order. We have never worked with more than a fourth the quantity as compared to earth, and I am convinced that we may reduce the amount required even to one-eighth. I have assumed, however, that we use a weight equal to the material to be removed.* The house may have a closet on each floor—say three, or even four; these are arranged one over the other. Each draws on the same supply of charcoal at the top of the house; the contents of the closet are allowed to fall through a 12-inch thin galvanised iron pipe into a water-tight cemented cesspit in the basement of the house. The charcoal reservoir is filled and the cesspit emptied by the scavenger once a year, the whole process being quite external to the house. The urine is emptied into a simple earthenware urinal in the closet on each floor, and it falls through a lead pipe direct into the pit, where there is always sufficient excess of charcoal to perfectly absorb it. The total absence of all odour is most remarkable. No water-closet can be compared to it. The quantity to be removed is reduced to less than twice the weight of the total excreta, and when removed an ordinary observer would scarcely know it from the original charcoal employed. The next step in the process is to remove it to the chemical works, where it is re-burned in iron retorts, the ammonia distilled off, and the charcoal returned to the householder. In small villages, one of the retorts at the gas-works will get through a large quantity, and the ammonia will add to the value of the gas-liquor. There is a constant increase of charcoal obtained from the excreta itself; this is an animal charcoal similar to that from bones; it contains the whole of the phosphates and the potash, and with the ammonia is available for manure.

The chemistry of the process has been so fully gone into before, on a former occasion, in another section, that I deem it unnecessary to refer further to it here; it will be found very fully described in several papers already published in the Chemical News.* I wish here to show how capable the process is of general extension. It is scarcely necessary to assure you that the cholera germs cannot survive the ordeal by fire which they suffer in this treatment. If, however, in case of cholera, further disinfection be desired, it can easily be effected when the whole excreta of the house is in a small pit, and in any case it is removed from our neighbour's contamination. A remarkable proof of the wonderful freedom from odour is described in a former paper.†

The process is now being worked by a small company, called the Nitro-Carbon Manure Company, Limited, established by a few gentlemen to show that the process, even on a comparatively small scale, can be made a commercial success; all are satisfied as to its perfectly fulfilling all sanitary requirements. Several of the principal shipbuilders on the Clyde are erecting the necessary closets and urinals in their yards, and in a few weeks these will be used by about 10,000 men. In re-burning the material the retorts to be employed will be Norman's patent twin rotary retorts, now much used in the principal sugar houses in Glasgow. An arrangement has been made with the shipbuilders to allot them shares in the Company to the value of the closets erected, and thus these employers of labour will share in any profit which may be made. If the process pays as well as we expect, it must rapidly extend; but as I know you will deem it your duty to examine every possible solution of the sewage difficulty, I make no apology for bringing it under your notice at this stage. Now, in estimating the profits of any chemical process as compared with irrigation, it is quite proper to value the manure produced only by chemical analysis. Her Majesty's Commissioners adopt this course; they attach little importance to farmer's certificates, but value entirely by chemical analysis. This is the only fair way, because it shows exactly what it is worth in open market; and, valued in this way, all the manures produced by the several sewage companies are comparatively worthless. Yet, although this has been abundantly proved, why are the shares at such a premium? But in comparing the value of irrigation with that of any chemical process dealing with sewage, they bring in another and, I submit, an improper

* The remarkable drying action of the charcoal before alluded to was singularly shown in one house, where the contents of a wash-basin had been daily emptied into the urinal and found its way into the vault for twelve months before it was accidentally discovered. *The manure, when* removed from the vault, was apparently quite dry.

* Chemical News, vol. xix., pp. 253, 269, 291; vol. xx., p 196 and vol. xxii., pp. 289 and 301.

† Chemical News, vol. xxii., p. 303.

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element, *i.e.*, the total profit of the farmer. This is unfair; the farmer buys his manure—say, made from bones, or, say, from excreta—by analysis at its market value, and his living is made out of what that investment produces from the land. The irrigationists have no right to put themselves in his place, reap his profits, charge themselves nothing for the sewage, and call that "making it pay." In one of the accounts quoted in Her Majesty's Commissioners' Report, the "right of shooting over the farm" is actually entered as an irrigation profit!

We have hitherto used the ordinary earth-closets of Moule's patent, simply throwing smaller charges of charcoal in coarse lumps; these have been wonderfully successful, but in order to use fine granulated charcoal, and to considerably lessen the quantity required, it was necessary to invent a closet for this special application. I applied to my friends, Messrs. Pollock and Pollock, engineers, of Leeds, and the closet exhibited is the result of their ingenuity.* It delivers a minimum, but accurately measured quantity, and places it exactly where it is required; and it is remarkable what a small quantity of the deodoriser is sufficient to keep the deposit perfectly free from odour.

I exhibit also the plans for workmen's closets; and when I add that in all the yards where these are being erected they are to supersede large and expensive ranges of iron buildings and water-closets, you will understand that their great advantages have been already proved to the satisfaction of those pioneers of successful engineering, the shipbuilders on the Clyde. The impossibility of stopping their action and rendering them offensive is highly important. An instance of the extreme difficulty of dealing with factories is mentioned in a former paper.† The almost universal experience is that the water-closet is unsuitable for factories. But owners of private houses are beginning to think in the same direction, or why do we so constantly find disinfectants still employed? If the water system is or can be made perfect, why should such agents ever be required? These disinfectants have all, more or less, a disagreeable odour, are all expensive, add nothing to the value of the product, and confess the weakness of the water-closet system.

I think, therefore, the method of the future must be some such modification of the dry process as that now referred to as the carbon closet system.

ACTION OF NITRIC ACID ON CHARCOAL.

(PRELIMINARY NOTICE).

By ANDREW SCOTT.

IN consequence of a paragraph in the CHEMICAL NEWS (vol. xxv., p. 21), taken from the *Scientific American*, announcing that Professor Schulze had succeeded in oxidising charcoal with permanganate of potash, obtaining thereby oxalic acid and a number of interesting products, I beg to give notice that I have spent a portion of my leisure for the last few months in examining the action of nitric acid on charcoal from various sources, and that I have obtained a compound containing over 30 per cent of carbon, 2 to 3 per cent of hydrogen, the remainder being chiefly nitrogen. It is a black amorphous substance, very soluble in water, alcohol, ether, &c. It is very deliquescent, absorbing 20 per cent of its weight of water in a few days, and becoming a dark liquid, the water being again expelled in a short time at the temperature of the water-bath. When heated on platinum foil it takes fire, the combustion spreading rapidly through the mass. Heated in a test-tube it melts, swells considerably, and gives off nitrous fumes. It combines with alkalies, and the solutions give precipitates with most of the metallic salts. Its watery solution is also precipitated by hydrochloric and sulphuric acids. I have prepared this body from willow charcoal, coke from crude paraffin oil, bone charcoal, and from mineral charcoal found in ordinary household coal.

I would have had the analysis of this substance finished by this time, but for the circumstance that it requires a most unusual length of the combustion tube to be filled with copper turnings, a fact which was only apparent on attempting to estimating the nitrogen, after losing some weeks' work on the determination of the carbon and hydrogen.

Addiewell Chemical Works,
February 5, 1872.

* This closet can be obtained of the Carbon-Closet Company, [illegible] Street, Leeds. It was figured in the *Engineer* for [illegible] by.

† CHEM. NEWS, vol. xxii., p. 302.

NOTES OF DEMONSTRATIONS ON PHYSIOLOGICAL CHEMISTRY AT ST. GEORGE'S HOSPITAL.

By S. W. MOORE.

X.

ENTERING the duodenum in conjunction with the pancreatic juice is the bile, a secretion very complex, and in its morbid states causing much trouble and suffering. It has the constitution of a soap, and serves as an excretion as well as secretion; the liver is the gland which is actively engaged in its separation.

Bile consists of glycocoll and taurine combined with cholic acid, and these again combined with soda, forming glycocholate and taurocholate of soda; there are certain of the true fatty acids in the bile, as palmitic and stearic. The cholochrome or colouring matter of the bile consists essentially of two parts obtained by decomposition, cholochloine and cholophæine.

Cholesterine is abundant in the bile, mucus is also present from the bladder, phosphates of lime and magnesia also exist with other salts, and a trace of copper is found in the ash.

The bile is neutral or alkaline; on standing it decomposes and gives an acid reaction, the taurocholate of soda being decomposed into cholate of soda and taurine, the glycocholate of soda into glycocoll and cholate of soda. On further decomposition the acidity becomes more marked from the development of valerianic acid; the cholate of soda is broken up into cholic acid, which precipitates, and a new salt is formed from the soda and valerianic acid. Cholochrome is also deposited, and the glycocoll yields acetic acid and ammonia.

The purified ox-bile of the pharmacopœia is prepared by precipitating the mucus with rectified spirit, and drying the clarified fluid by evaporation.

Bile acts as a natural purgative, is powerfully antiseptic, and emulsifies the fatty portion of food. The cholesterine of bile frequently separates, forming gall-stones, colouring matter generally being contained in them; cholesterine is freely soluble in hot alcohol, but crystallises out on cooling.

The colouring matter and the biliary resins are often present in secretions as morbid products, and two tests have been devised for their identification. If cholochrome be suspected, take a few drops of the fluid and place them on a porcelain dish, to this add a few drops of hydric nitrate (HNO_3); a play of colours gradually takes place when this body is present, known as the chameleonic changes. The biliary resins also undergo a colour change when a portion of syrup is added, and then a few drops of sulphuric acid. I always find it best to mix the bile and syrup in one test-tube, and pour it on to a few drops of the acid at the bottom of another; this is known as Pettenkofer's test.

Space will not allow us to enter into a discussion on the various theories of bile formation, &c., but they will be considered elsewhere.

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ON THE MANUFACTURE AND REFINING OF SUGAR.*

By C. HAUGHTON GILL.

(Continued from p. 54).

THE juice, therefore, has now been defecated, carbonated, sent up stairs, heated to boiling, so as to decompose any remaining bicarbonate of lime in the solution, and to raise its temperature, so that the charcoal may have a greater action upon it, and it has then been allowed to run down through a column of animal charcoal 15 or 18 feet deep. The thin juice, as it is now called, issuing from the bottom of the charcoal, has become decolourised, somewhat freed from the lime, and from the gummy and albuminous bodies which the lime had failed to remove. The next process is to concentrate it, or to remove from this thin juice—and, as a rule, it is very thin—a great portion of the water which it contains. This is effected in the ordinary way by boiling.

In the older processes this was done by simply putting the juice into open pans, and putting a fire under them, in the same way as cane sugar is treated, but this method is no longer adopted. It is now done in an apparatus, which I may call a double effect apparatus, because the heat is used twice over, for the purpose of evaporating the liquid. The juice is put into a vessel somewhat resembling a locomotive boiler, being heated by steam, which passes into a number of pipes which run through the boiler, while a very partial vacuum is created above. When the steam is hot enough to make the liquid in the vessel to boil rapidly it goes off in steam, but instead of sending it out into the air, and wasting the heat contained in this vapour from the boiling juice, it is made to pass by a tube into the tubes of the second vessel similar to the first, and though the temperature of the vapour thus obtained from the first pan is not high enough to make the liquid in the second vessel boil with any degree of rapidity at the ordinary atmospheric pressure, by connecting the top of No. 2 vessel with an air-pump, and a condensing apparatus, so that the contents of the second vessel boil much below the usual temperature, this slight difficulty is entirely got over, and thus nearly the whole of the heat given off by the steam is utilised. If the steam coming from the original boiler were capable of evaporating, say, 10 lbs. of water out of the first vessel, theoretically, if there was no loss of heat, the vapour from the juice in that vessel should, on passing into the second vessel, be also capable of evaporating another 10 lbs. there, but practically it does not do anything like so much work; but still there is a considerable saving of fuel by employing two vessels connected in this way. In some factories three such evaporating vessels are connected together, but I believe the saving effected by using a third is very small, because the practical loss of heat is very considerable.

In this double effect apparatus the juice is brought to what is technically termed 25° Baumé, which I may explain thus. I will put into this jar some water, and I then put into it a little apparatus called Baumé's areometer, which, when immersed in water, sinks down until the top of the graduated scale is just on a level with the water in the jar. Now I will mix with the water some sugar, and we shall find that the liquid has become heavier, bulk for bulk, than the water, and in consequence the float will not have to sink so far into it in order to displace a quantity of the liquid equal to its own weight, but will float higher out, and higher in proportion as there is more sugar in the liquid. This is the kind of instrument which is constantly used in sugar factories to roughly determine the strength of the various solutions of sugar. When the juice is so far concentrated that this little float only sinks in it so far as the mark 25, it contains about 45 per cent of its weight of total solids, including sugar, in solution. From this preliminary concentration, the juice, now technically "thick juice," goes to a cistern in which it is heated to boiling, and is then again filtered through fresh animal charcoal, to remove more of the colouring matters still present, and some of the albuminous bodies which are more readily absorbable from dense than from thin liquids. After this second charcoaling, the juice is almost colourless, and very brilliant and transparent, but is still not a pure or by any means a saturated solution of sugar, and, accordingly, before the maker can obtain any sugar from it in the solid form, he is obliged to reduce the quantity of water still further. This he does by the use of the vacuum pan, the name of which, I have no doubt, suggests the nature of its construction. It is simply a pan, into which the liquid can be introduced and heated, while a comparatively perfect vacuum is formed above the surface, and in which, consequently, the liquid is capable of boiling at a very low temperature. [The lecturer then described, by means of a large diagram, the construction of the vacuum pan]. The liquid introduced into this vacuum pan of course loses water and shrinks, and from time to time more is added, until the pan is filled to a convenient height with the new and more concentrated liquor. At this point the admission of liquid is stopped for a short time, and the boiling is continued, until a sample, taken out by means of what is called a proof stick, is found to be of a certain degree of stickiness. At this time the liquid contained in the pan is a supersaturated solution of sugar—that is, a solution containing more sugar than the water present really ought to contain at that temperature. The problem which the man has to solve is, how to disturb that liquid in such a way as to bring about crystallisation. I showed you, by some experiments at our first meeting, that all supersaturated liquids cannot be disturbed in the same way. A solution of sulphate of soda might be disturbed in such a way as to promote crystallisation by merely shaking it, but one of hyposulphite of soda might be shaken vigorously without starting crystallisation. The problem, therefore, is how to start crystallisation in this supersaturated solution of sugar, at this comparatively high temperature, for, although it has boiled at a comparatively low temperature, it is still much hotter than an unaccustomed hand could bear. The right kind of disturbance in this case is, as a rule, to admit by little jerks small quantities of the liquor from which the boiled mass was made. The man, therefore, opens the cock, and lets in a small quantity of the thickened juice into the pan, and after a little time—the duration of which appears to me very uncertain, depending very much on the purity of the juice operated upon—the boiler, when he takes out the proof and examines it between his eye and the light, sees small grains of sugar beginning to appear. At this point he knows that crystallisation has begun, and when it has once started it proceeds very rapidly, and in a few minutes after they have once made their appearance, the whole mass of liquid in that pan is filled with a mass of very minute crystals of sugar floating in a syrup, which is a normal saturated solution for the temperature at which the crystallisation takes place. The excess of sugar forming the supersaturated solution is deposited, and we have now crystals floating in a solution only properly saturated for the temperature at which we have been operating. After the crystals have once formed, and we have this mass of crystals in the pan, little by little, more of the original solution is admitted, and so it is continually added and the water is evaporated until the pan becomes nearly full. The effect of doing it is this. As we admit a fresh portion of liquid into the pan, and evaporate off the water, the sugar crystallises out at once; it no longer forms a supersaturated solution, for we have present a great number of crystals on which it can deposit. The crystals which are first formed now continue to grow by continuous addition of sugar to

* The Cantor Lectures, delivered before the Society of Arts.

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their surfaces, and if this operation of adding to the solution of sugar and evaporating off the water be allowed to take place a sufficient number of times, and in a sufficient gentle manner, the crystals will become a very considerable size. I have here some samples of sugar made by this process, some of which are very fine specimens. Here is some of very nearly the first quality beet-root sugar, which is made in France in the way I have described. It has been boiled for twelve hours in this way. After they once get "grain," as it is technically termed, in the pan, they add fresh liquor in very small quantities, and evaporate off the water, so that there is a slow deposit of sugar on the grains already formed, so slow that it deposits in a comparatively regular manner, and when that occurs we get large-sized crystals. Here are some still finer, for which I am indebted to Mr. Duncan; indeed, it is the finest I have ever seen, though it is called raw beet sugar. It is made in England, from English-grown roots.

We understand now what has occurred in the vacuum pan. We have a mass of sugar crystals floating in a syrupy material, which consists of some water, a good deal of sugar, and all the impurities which the juice originally taken into the pan contained, because when crystallisation takes place, the crystals formed consist of only one kind of matter; therefore, as a rule, the crystals formed in this case are practically pure sugar, and, therefore, what is left behind when the crystals are separated out must contain all the impurities originally present, plus so much of the sugar as has not been crystallised on account of the water still present. The mass in that state, when the boiling is finished, is let out by opening a plug or slide valve in the bottom of the apparatus. I cannot show you a mass actually so formed from beet-root, because there is no beet-root factory in England in which they work exactly in the way I have described, and where they make these crystals from beet-root; and even if I could show you some of the mass as it comes from the pan, it would present a different appearance when exhibited to you from what it does when first drawn off, because it is then hot; and when it is cold, as it would be here, some of the sugar which the syrup contained when hot would be deposited, and would cement the crystals of sugar together, so that the mass would be somewhat hard. I have, however, prepared here what is not a bad representation of a mass as it comes from the pan, only I have rather too large a proportion of syrup. It is prepared by mixing some of the beet-root sugar crystals in an impure syrup. It is a hard sticky mass, which does not look a very promising material from which to extract pure white sugar. The sugar now has to be recovered from this. The old method was to put the mass into moulds of some kind, at the bottom of which holes could be opened, so that the syrup could gradually drain away and leave the crystals above, but that is a very slow process, and the syrup which actually adheres to the crystals is much more sticky than that which I have here. It therefore drains away very slowly, takes a long time in operation, and is, after all, very imperfect. It is necessary, therefore, for the rapid success of the operation, that we should employ some force to aid the draining of the syrup, and the mode usually adopted is to make use of a so-called centrifugal machine. You know that when anything is set rotating very violently on its axis, the outer particles of it at any portion of their course tend to continue their motion in the direction of a tangent to the circle at that point, and if you make the motion very rapid, the force which makes them tend to fly off becomes very considerable. I have here, owing to the kindness of Messrs. Wainwright, a model of a centrifugal machine, such as is actually employed. It consists of an outer casing of iron, inside which there is a drum strongly made, the sides of which consist of finely-perforated copper, or in some cases of woven wire, but at any rate it is pervious coating. Liquids are capable of passing through that coating, but solids are retained in the meshes. I will now pour in some of the mixture of syrup and beet crystals to the drum; and, while it remains at rest, very little, if any, will pass off. There is an opening in the outer casing, through which the liquid which passes into it may drain away conveniently. On setting the drum in motion you will find that the mass which was lying at the bottom becomes separated by the centrifugal motion and spreads itself up the sides of the drum, and as the motion is continued the liquor passes through the meshes, and the sugar is becoming quite white. The syrup is now running out very rapidly, and on increasing the speed of the drum, the sugar is spread evenly round the sides. When it is going at its highest speed I will dash on it a little water, which will be forced out through it and will slightly wash it, and thus help to carry away the last particle of syrup which might otherwise be left behind. On stopping the action, I can now scrape with my hand enough of the sugar to show you the nature of the operation that has taken place while the syrupy portion has drained away beneath.

In this way, and in this first operation, about three-fourths of all the sugar that can be obtained is obtained if the process is conducted successfully. The syrup that has drained away is obviously worth keeping. It is a saturated solution of sugar, and for every pound of water we have there we have at least two pounds of sugar, for one pound of water will dissolve that quantity of sugar. It is obviously necessary to recover as great a quantity of that sugar as possible; the syrup is therefore treated in the following way:—The principle is very simple, although the details of the process are somewhat complicated. The solution is concentrated to a convenient point, and allowed to stand for a considerable time. It is concentrated in a vacuum pan, similar to that I have described; but it is found on the second concentration that you are no longer able to get grain formed in the pan. If the original solution or liquor is very impure, it is much more difficult to disturb that state of supersaturation than if it is comparatively a pure solution of sugar. Now this syrup that has been drained away is far more impure than the original thickened juice which we evaporated, and, accordingly, it is not possible to get crystals of sugar formed in the pan during this second concentration. But the liquid having been thickened to the degree which experience has found necessary, is run into large iron tanks, where it is allowed to stand for a fortnight or three weeks, and kept at a moderately high temperature. Crystallisation then slowly takes place, and the mass is then stirred up with some fresh syrup, and put through the centrifugal machine again. This constitutes the second product of factories, of which I have two samples here. The result is, of course, less pure, both in appearance and in reality, than the first product, owing to the crystals retaining on their surfaces a large proportion of the still more sticky mother-liquid than the first did, and not only a larger proportion of that, but this mother-liquid itself is more impure; consequently the whole mass contains a much greater proportion of impurities than the first crop. The syrup from this second product is again concentrated, but by this time it is so impure that before crystallisation can be brought about after it is concentrated, it has to be kept for six months in tanks at a comparatively high temperature. At the end of that time, a comparatively small quantity of sugar has deposited out. Some of such sugar I have here, but I am bound to say it is the worst I ever examined. It looks very nice, but if there are present any persons practically acquainted with sugar, they will be surprised to hear that it contains over 9 per cent of salts, although it is an apparently bright, and what is technically termed "free" sugar. This leads me to mention very briefly the fact that, if in a concentrated solution of sugar you have various other matters, if you only give it time enough, it will crystallise out in actual chemical combination with some of these salts, and, consequently, this

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third product, which stands a long time, and which is formed from the mother-liquid containing a large proportion of impurities, is not merely pure sugar coated with impure syrup, but is actually an impure product, itself also coated with syrup, and is, consequently, often very much contaminated with salts.

The syrup which drains away from the third product has no longer any value to the sugar-maker, but is sold for the purpose of making spirits from. It is diluted, fermented, distilled, and thus is obtained a crude beet-root spirit, which is afterwards rectified, duly flavoured, and sold as French brandy.

(To be continued).

NOTICES OF BOOKS.

Spectrum Analysis in its Application to Terrestrial Substances, and the Physical Constitution of the Heavenly Bodies. Familiarly explained by Dr. H. Schellen, Director der Realschule I. O. Cologne, Ritter des Rothen Alderodens IV., K.L., &c. Translated by Jane and Caroline Lassell. Edited by William Huggins, LL.D., D.C.L., F.R.S. London: Longmans and Co. 1872.

This admirable work does credit to, or should we say is worthy of, the author, the translators, and the editor; while their endeavours have been ably carried out by printer and by publisher. The first part treats on the artificial sources of high degrees of heat and light; the second on spectrum analysis in its application to terrestrial substances, while the third is devoted to spectrum analysis in its application to the heavenly bodies. There are three appendices, "On the Cause of the Interrupted Spectra of Gases," by G. Johnstone Stoney, M.A., F.R.S.; "Preliminary Catalogue of the Bright Lines in the Spectrum of the Chromosphere," by C. A. Young, Ph.D., Professor of Astronomy in Dartmouth College, and a list of works and papers on spectrum analysis. We must approve the method followed in the translation and by the editor. In many translations the views of the author are supressed in order that the views of the translator or editor may be expounded; but here Dr. Huggins, however leniently such a fault might have been looked upon with him, has permitted the author's views to remain intact, clearly stating his own and wherein lies the difference. Thus the uninitiated are imperceptibly led into a course of reasoning that affords infinitely better tuition than would be obtained by whole reams of mere description.

Spectrum analysis, with regard to terrestrial substances, has been so fully gone into in these pages that we cannot, without repetition, submit an extract interesting to our readers, and the spectra of the heavenly bodies do not fall within the scope of this journal. But we none the less heartily refer our readers to the work.

The original in the German includes a table of spectra, Kirchhoff's maps, plates of the total solar eclipse (1868, India, and N. America), the solar spectrum of the prominences during a total eclipse, the solar prominences observed by Zöllner and Young. To these the translators have added Angström's maps of the solar spectrum, the corona photographed at Syracuse by Mr. Brothers, and the solar prominences observed by Respighi; while the subject-matter is illustrated with many well-executed woodcuts.

Memoranda on Poisons. By the late Thomas Hawkes Tanner, M.D., F.L.S. Third and completely revised edition. Renshaw. 1872.

The editor of this well-known and useful little book has been wise enough to perceive that its chief value is for students. He has adopted a new and more sensible classification of poisons, and has evidently taken great pains in the selection of the best methods of testing for such. The medical bearings on this subject are also treated with great clearness and succinctness. Nevertheless, although the book will be found useful by many practitioners, the analytical details are, of necessity, far too brief to render it a sufficient guide for the practical toxicologist. For the student, on the other hand, it is thoroughly well adapted, as it contains all he is required to know, even for the lengthy examinations, without containing more than he can easily master.

CORRESPONDENCE.

LOSS OF SODA IN LEBLANC'S PROCESS.

To the Editor of the Chemical News.

Sir,—In your issue of the 2nd inst. (vol. xxv., p. 54) is an abstract of a valuable paper, read by Mr. James Mactear before the Glasgow Philosophical Society, "On the Loss of Soda in Leblanc's Process." As the results obtained by this gentleman differ in many respects from those formerly obtained* by myself (as pointed out by him), permit me to discuss some of the reasons for these differences.

In the matter of the loss caused by the formation of insoluble sodium compounds left behind in the waste, Mr. Mactear considers 5·44 per cent of the sodium employed as sulphate (the number I obtained as an average of about ten months' production in an alkali works in the Lancashire district) to be "exceptionally high." During the last two years I have been enabled, through the kindness of Mr. I. Lowthian Bell, to make some observations on the amount of insoluble sodium compounds contained in the waste of an alkali works in the Tyne district, where chalk is used in the balling process; and though these experiments were not carried out with any degree of minuteness, still they indicated a somewhat less loss than that in the Lancashire works, where limestone was used, viz., about 4 per cent as against 5·44. On the other hand, M. Scheurer-Kestner (Chemical News, vol. xxii., p. 267, from *Comptes Rendus*, June 20, 1870) concludes, from his own experiments, that the loss from this cause "certainly is never less than 5 per cent, and often very much larger." I am disposed to think that the insoluble double compounds are mainly calcium-sodium carbonate, formed from the excess of caustic lime in the black ash during the lixiviation; and hence the proportion of limestone or chalk and its physical character will greatly influence the result. The latter substance is likely to mix better with the fritted ash materials, and the ball soda produced will contain fewer "plums" or lumps of more or less cauticised calcium-carbonate disseminated through the mass.

As to other sources of loss, it is expressly stated in my paper that the capabilities of production of the plant were strained to the uttermost during the period of experiment, so that the losses observed are probably the maxima consistent with remuneration; thus the high percentage of NaCl in the salt-cake is accounted for, likewise that of unchanged Na_2SO_4 in the black ash. As regards the former point, I may observe that 5·31 was the average of undecomposed NaCl in the materials employed in the balling process, including salt-cake of inferior or damaged kinds, imperfectly furnaced, and containing large quantities of NaCl, from the circumstance that the nitre-cake (impure $NaHSO_4$) was mixed with a large excess of salt, and roasted—a proceeding which is rarely effectual in destroying all the acidity of the nitre-cake, and always risks the employment of too much or too little salt. Salt-cake of average quality from the salt-cake furnaces alone contained much less NaCl than this average—viz., about 3 per cent only or less. This little circumstance just shows the extreme difficulty in obtaining correct data for calculation in such cases; in fact, without an enormous amount of personal labour on the part of the experimenter it is impossible, as the samples taken by workmen cannot be relied on as representing the true average.

* *Journal o the Chemical Society*, 1867, 407.

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Two circumstances may possibly concur in making Mr. Mactear's results appear higher than mine. In the first place, it is usual in alkali works to assume the combining number of soda as 32 instead of 31 (O=8), and if the standard acid employed be graduated in one way, the result is that 31 parts of available soda are counted as 32, making an apparent increase in the yield of 3·2 per cent. Sometimes, however, the acid is graduated on the supposition that sodium-carbonate contains 59·26 per cent of Na_2O (Na=24) instead of 58·49 per cent (Na=23); if this method is employed, the results come out 1·4 per cent too high. In reference to this point, I may here reiterate that I have never known an instance on the west side of England where soda-ash invoiced at 48 per cent, and reported at such a percentage by trade analysts, actually contained more than 46·5 per cent of compounds capable of neutralising sulphuric acid, and calculated as Na_2O; the amount of available soda contained being frequently even below this.

In the second place, ordinary soda-ash contains a small percentage of calcium-carbonate, and frequently a somewhat considerable one of aluminate of sodium; the CaO and Al_2O_3 of these compounds neutralise acid, and are reckoned as Na_2O (as is also the Na in sodium-silicate, sulphite, and hyposulphite, which are usually present in soda-ash, but are of questionable value to the consumer). It is probably not beyond the mark to suppose that 1° of the percentage estimated by test-acid is caused by the presence of CaO and Al_2O_3; this amounts, in the case of a 48 per cent ash, to 2·1 per cent on the available alkali present.

In my estimations both these sources of error were carefully guarded against. Assuming them both to exist to their probable maximum amounts, it is evident that a loss of 3·2+2·1, or upwards of 5 per cent (1 cwt. per ton), of sodium might exist in the manufacture, which would not be revealed to the manufacturer by his book of "returns;" from instances that have come under my own observation, I have no doubt that in many alkali works losses exist to even greater amounts than these of which the manager is entirely unconscious.

Mr. Mactear's quoted numbers ("100 parts of common salt gave 86·318 parts of ash of 48 per cent strength") only bear out his calculation on the assumption that 100 parts of salt should, theoretically, yield $\frac{86{\cdot}318}{85{\cdot}91} = 100{\cdot}47$ parts of ash at 48 per cent, which necessitates that the salt should contain 9 per cent of water and other substances. One hundred parts of pure NaCl would yield $\frac{31}{58{\cdot}5} \times \frac{100}{48} \times 100 = 110{\cdot}4$ parts of 48 per cent ash; but if 9 per cent of the body used were not NaCl, the theoretical yield would be $\frac{91}{100} \times 110{\cdot}4 = 100{\cdot}464$ parts of 48 per cent ash. The determination of the actual *average* amount of water in large quantities of damp salt exposed to drying and wetting agencies of transit, weather, storage in warm or moist places, &c., is a matter of great difficulty, if not impossibility, but indispensable when the calculations are made out "per salt decomposed;" if the salt operated on had been pure NaCl, the total loss would have been $\frac{110{\cdot}4 - 86{\cdot}318}{110{\cdot}4}$, or 21·8 per cent, so that it is evident that an error in the determination of the average moisture in the salt used vitiates the whole calculation.—I am, &c.,

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MISCELLANEOUS.

Xylol.—This hydrocarbon is likely to become of great importance, if its application in cases of small-pox is really followed by such good results as have hitherto been obtained at Berlin. The Berlin *Klinische Wochenschrift* states that Dr. Zuelzer, Senior Physician at the Charité Hospital, had there administered xylol in cases of small-pox, with the most comeplete success. It is given in doses of from 3 to 5 drops for children, 10 to 15 drops for adults, every hour to every three hours. It is harmless, because as much as a teaspoonful at a time has been taken. The most convenient form of taking it is in capsules, as already supplied by a Berlin firm, and containing 3, 5, 8, and 12 drops each. The specific action is not yet clearly defined, but early information on this point is promised. The theory at present is that xylol is taken up by the blood, and acts as a disinfectant. The absolute purity of the xylol is important, as toluol and other analogous compounds do not possess this peculiar action, and it seems there are some practical difficulties in obtaining xylol absolutely pure. Xylol, or xylene, C_8H_{10}, was first separated from coal naphtha by Dr. Hugo Müller; it is obtained by fractional distillation until a distillate is obtained of about 140° C. boiling-point; this is mixed with sulphuric acid, which dissolves xylol, forming xylol sulphuric acid; this acid is decomposed by dry distillation, and the xylol thus obtained is further purified. Pure xylol is colourless, it has a faint odour, somewhat like benzol, but different; boiling-point, 139° C.; sp. gr., 866.—*Pharmaceutical Journal.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, January 15, 1872.

This number contains the following original memoirs and papers relating more particularly to chemistry:—

Combustion of Carbon by Oxygen.—J. Dumas.—This very lengthy and exhaustive essay, written more especially to refute the theory of Dr. Dubrunfaut on the combustion of carbon by carbonic acid in the presence of water, is, notwithstanding its high scientific value, not well suited for any useful abstraction, an observation equally applicable to the following memoir:—

Measurement of Very Elevated Temperatures, and on the Temperature of the Sun.—H. Sainte-Claire Deville.

Electrisation by Friction Observed in Sulphide of Carbon, and Decomposition of that Body by the Light.—Th. Sidot.—In the first portion of this paper the author states that when pure sulphide of carbon is placed along with granulated silver or any other granulated metal in a stout glass bottle, and this vessel vigorously shaken, electric sparks are seen inside the bottle; when, while this phenomenon is observed, water is poured on the bottle, the appearance of the sparks ceases immediately, but the phenomenon is observed again when the shaking is continued. By being exposed for several months to strong sunlight in a sealed tube, pure sulphide of carbon appears to become decomposed, giving rise to a solid, flocculent, red-coloured matter and a pecular kind of gas, but the author has not yet been able to test the nature of these products.

Conversion of Phenol into Alkaloids.—L. Dusart and Ch. Bardy.—After first referring to the discoveries of Drs. Laurent, Hofmann, Sterry-Hunt, and others in this department of chemistry, the authors, while minutely describing their method of experimenting, state that the result of heating together in a sealed tube, at from 310° to 320°, a mixture of phenol, sal-ammoniac, and hydrochloric acid, is the formation of chloride of phenyl, some phenylamine, and a large quantity of diphenylamine.

Production of Cymen from the Hydrate of Oil of Turpentine.—Ph. Barbier.—By first treating crystallised terpine—

$$C_{20}H_{20}O_4 + H_2O_2,$$

with bromine, there is formed a compound which appears to be a bromated derivative from a bromhydrate of terpilen; this body, on being submitted to distillation, yields a large quantity of bromhydric acid and a hydrocarbon which, on being purified, was found to boil at from 176° to 179°, to have at 15° a sp. gr. of 0·864, and to yield on being analysed results identical with those given by cymen, viz., in 100 parts—Carbon, 89·55; hydrogen, 10·45.

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Note Relating to the Reaction which is Produced between Sulphur and Steam, to the Synthesis of Sulphuric Acid, and to the Preparation of Pure Zinc by Electrolysis.—Dr. V. Meyers.—This memoir is divided into the following sections:—Reaction between boiling sulphur and steam; synthesis of hydrosulphuric acid; preparation of pure zinc by electrolysis.

January 22, 1872.

This number contains the following original papers and memoirs more especially relating to chemistry:—

Simultaneous Distillation of Water and Iodide of Butyl.—I. Pierre.—From the description of the author's experiments, illustrated in this paper by a woodcut representing the delineation of the phenomenon of the ebullition of the two fluids alluded to, the following conclusions can be deduced:—When butylic iodide and water are distilled together, the ebullition of this mixture takes place at 96°, that is to say, that the boiling-point is lowered by 26·5°; this degree of ebullition remains unchanged as long as the two liquids are in contact with each other, and appears to be independent of the relative proportions of the two fluids. The proportion of liquid distilling over is 21 of water to 79 of iodide of butyl; this relative proportion is independent of that of the quantities of the two liquids contained in the retort. Ethylic iodide behaves in a similar manner; when in the presence of water, the mixture regularly boils at 66°, while this iodide boils by itself at 70°; the only difference is that the quantity of water distilled over in this instance is only from 3 to 4 per cent.

Report on a Memoir of M. Grüner on the Action of Oxide of Carbon upon Iron and its Oxides.—H. Sainte-Claire Deville.—Notwithstanding the very high intrinsic merits of this lengthy essay, its contents are not suited for useful abstraction, an observation also relating to the following paper:—

Researches on the Induction Currents of an Electro-Magnet between the Poles of which a Metallic Disc is Made to Move.—H. de Jacobi.

Analytical Method of Separation of the Two Isomeric Toluidines from each other.—A. Rosenstiehl.—The author describes at great length a process of volumetrical analysis, which is based upon the different compounds which the two isomeric toluidines form with oxalic acid. The crystalline toluidine forms with oxalic acid only one combination, viz., an acid oxalate—

$$C_9O_4H_9.C_7H_9Na.H_2O;$$

this salt is at 15° soluble in 125 parts of water and in 6600 parts of ether free from alcohol. Pseudo-toluidine forms two oxalates, one of these, $C_9O_4H_9.C_7H_9N\beta.H_2O$, is at 18° soluble in 200 parts of ether; the other, a neutral and anhydrous salt, $C_9O_4H_9.(C_7H_9N\beta)_2$, is at 18° soluble in 267 parts of ether. The author first prepares ether free from alcohol (it is not necessary that the ether should be anhydrous); next, a solution of 5 grms. of pure toluidine (which becomes solid at 45°); and, lastly, a solution of oxalic acid, equivalent volume for volume to the preceding solution. By means of a preliminary assay, the purity of the ether is tested, for which purpose 12 c.c. of that ether are taken, and there is added to that bulk of fluid 0·2 c.c. of the two titrated liquids; the result is the formation of 0·0022 grm. of acid oxalate of toluidine, requiring for its solution 16 grms. of ether, and, if this liquid is sufficiently pure (free from alcohol in this case), the oxalate should not be all dissolved, but a portion thereof remain adhering to the sides of the test-glass in the shape of small crystals. The assay of a sample of toluidine is effected by taking first 0·2 grm., and dissolving this in 80 grms. of ether; next, the oxalic acid solution is added by means of a burette; a precipitate of the acid oxalate is formed at once, but, in order to ascertain the end of the operation, it is necessary to filter a portion of the fluid, and to add one drop of the oxalic acid solution, which should yet produce a precipitate of small crystals of the oxalate at the surface of the liquid adhering to the glass. In order again to be sure that no excess of the oxalic acid solution has been added, it is necessary to test with the titrated toluidine solution, while, as regards the precipitate just mentioned, it should be tested for being really a salt of toluidine.

Preparation of Ozone in Concentrated State.—A. Houzeau.—This paper contains the description of a contrivance for the preparation of larger quantities of ozone, the instrument herein alluded to being named an *ozoniseur*; the author is engaged with a series of experiments, the results of which will be communicated at a future date.

Les Mondes, February 1, 1872.

This number opens with the programme of what the excellent editor aptly terms—

Salle du Progrès Soirées et Matinées de Science Illustrée.—Rev. F. Moigno.—We are glad to hear of the efforts made by the *savant* just named for the purpose of procuring to the middle and labouring classes of Paris useful and recreative rest from toil and labour, by providing instruction and recreation for the people, viz., musical entertainments; lectures on various subjects belonging to different sciences, illustrated by experiments, specimens, diagrams, oratorial exercise, and reading; applied sciences, and review of the scientific and industrially remarkable novelties of the day. Provision is made for the daily distribution of gratis tickets, while, further, the price of admission to these halls (seven are now open) is very moderate indeed. We sincerely wish this good work all the success it deserves in the interest of the sound regeneration of France, and more especially the inhabitants of its capital. "Fluctuat nec *mergitur*."

Electrical Turbine.—M. Ruhmkorff.—The description, illustrated by a woodcut, of a very neat and ingeniously contrived apparatus for demonstrating the direction of electric currents.

Economical Industrial Production of Ice and Cold.—Ch. Tellier.—The author describes at length an arrangement and apparatus whereby the vapourisation of ether is employed for the production of intense cold, provision being made to recover the ether in a very ingenious way, by causing it to be absorbed by sulphovinic acid, from which it is afterwards again separated by a simple distillation. An apparatus is now being made according to the author's instructions with which it will be possible to manufacture a ton of solid ice per hour, while the apparatus, of great simplicity and without any complicated fittings, will admit of constant action, and thereby making the ice at a very low price.

Spontaneously Explosive Compound.—Rev. F. Moigno.—When finely pulverised chlorate of potassa is put upon a piece of paper (best dredged or dusted over it, so as to form a thin film of powder), and there is next poured over it a solution of phosphorus in bisulphide of carbon, there ensues, when the latter is evaporated suddenly, a most violent explosion, owing to the phosphorus being left in a state of extremely minute division and in intimate contact with chlorate of potassa. This explosion is analogous to that which ensues when a small piece of phosphorus and some chlorate of potassa are, when placed upon an anvil, struck with a hammer, but, in the instance alluded to, the effect produced is greater, owing to the extreme state of division and intimate mixture of the two substances. Care should be taken not to make this experiment with too large quantities of the chlorate and phosphorus solution, for fear of serious accidents which might ensue.

Bulletin de la Societé d'Encouragement pour l'Industrie Nationale, November, 1871.

This number does not contain any original papers on chemistry, but we abstract from the programme of the Industrial Society of Amiens (Département de la Somme) the following prize questions relating to chemistry:—Analytical experiments of divers kinds of butchers' meat; researches to be made on its varying nutritive quality, and on the relation existing between that property and the composition of the meat; horse-flesh to be included in this investigation; gold medal. To find a compound which, in dyeing wool, may be used instead of bitartrate of potassa for such colours as require this ingredient and tin salt; the compound ought not to contain any tartaric acid or combination thereof; £40 and gold medal. The gold medal for any important improvement in the bleaching of wool or silk. Treatise, theoretical and practical, and investigation of the divers methods applied in industry for the bleaching of hemp; gold medal. Manuscripts of memoirs, samples, &c., are to be sent postage and carriage paid, to the President of the Industrial Society, 48, Place Saint-Denis, at Amiens, on or before June 15 next, but not later.

La Revue des Scientifique de la France et de l'Etranger January 13, 1872.

Chemical Society of Paris.—We meet here with a brief account of the proceedings of the last meeting of this institution (January 5, 1872), from which account we quote the following particulars:—"Dr. Bourgoin states that he has tried to obtain oxymaleic acid, $C_4H_4O_5$, which should only differ from malic acid by two atoms of hydrogen less; for this purpose he has heated one molecule of bromo-maleate of silver, $C_4HBrO_4Ag_2$, with one molecule of bromo-maleic acid, $C_4H_2BrO_4$; hereby all the bromine is eliminated as bromide of silver, and an acid is obtained which is probably oxymaleic acid, $C_4H_4O_5$, but which has not yet been analysed by the author. By successfully treating the chlorated derivatives of anthracen with nitric and sulphuric acids, Dr. Schützenberger states that he has obtained a red-coloured needle-shaped crystalline compound which resembles alizarine, but differs from it by its insolubility in alkalies and composition, $C_{14}H_8O_5$ (alizarine being $C_{14}H_8O_4$). The new body alluded to is converted by being heated to 300° into yellow-coloured anthraquinon, while by being again treated by hyposulphite of soda in solution the substance is reduced and again becomes red-coloured.

This number also contains the following original paper:—

Physico-Chemical Conditions of Living Beings—Animal Heat.—Dr. C. Bernard.—The reproduction of a lecture given by the celebrated *savant*.

January 20, 1872.

This number does not contain any original papers relating to chemistry, but we call attention to the following memoirs:—

Free Universitary (Higher) Instruction.—Dr. P. Lorain.—This portion of this essay treats on the power of the state over public instruction; universities as purely ecclesiastical institutions; origin of the University of Paris; royal power (viz., as exercised in the olden time as regards universities); claims of the Society of Jesus in reference to public instruction; universities of the future.

The Coal Formation.—Dr. C. Contejean.—A very clear and succintly written paper on everything which bears upon the origin, mode of formation, and fossils of the carboniferous sedimentary rocks.

January 27, 1872.

This number opens with an exhaustive—

Report of the Committee of Inquiry on the Newly Built (as yet Unfinished) Hôtel-Dieu, in Paris.—Dr. P. Lorain.—The

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unanimous conclusion of the nine gentlemen forming this Committee is that the building alluded to is absolutely constructed against all rules of sound hospital hygiène, and therefore should not be used for the purpose for which it has been constructed.

Lecture on Anthropology.—Dr. Quatrefages.—We call attention to this paper on account of the very interesting facts quoted and proved by the author in reference to the origin and causes and effects of intermingling of the inhabitants (different races) now living in Europe.

This number contains a condensed well-written report of the proceedings of the meeting of the Chemical Society of Paris held on January 19, but, as regards abstracting from this paper, we deem it better to await the publication of the *Bulletin Mensuel* of this society.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, January 4, 1872.

This number contains the following original papers and essays:—

Note on the Class of Bodies Designated as Alcohols in Chemistry.—Dr. Hamel.—The author gives in this excellent paper a succinct and very clear review of the subject just named, elucidating his dissertation by a tabulated form, exhibiting for monoatomic, diatomic, triatomic, tetratomic, and hexatomic alcohols, the formulæ of these different bodies, and also explaining the real meaning and origin of the word alcohol.

Automatic Acting Plug for Preventing Foul Water and Noxious Gases from Escaping from Sinks, Sewers, &c.—MM. Nillus and Roussel.—Illustrated by woodcuts. This contrivance has met with great success in Paris, and is arranged to withstand considerable pressure.

Continuation of Essay on Fermentation.—C. Mène.—An excellent historico-critical review is here given on this much discussed subject.

January 11, 1872.

This number does not contain any original matter relating to chemistry.

Bulletin de l'Académie Impériale des Sciences de St. Petersbourg, Vol. xvi., No. 6, 1871.

This number does not contain any original papers relating to chemistry.

Journal de Pharmacie et de Chimie, January, 1872.

The papers and memoirs on scientific chemistry contained in this number have already been published in the *Comptes Rendus*; among the pharmaceutical papers we notice—

Some of the Tests for Detecting Strychnia.—Dr. Filhol.—After having reviewed the various tests described in works of chemistry, the author concludes that as regards the sure detection of this alkaloid in cases of poisoning it should be obtained in a solid state; the alkalinity of its solution should be ascertained as well as its intensely bitter taste; its behaviour with chlorine, and its blue colouration under the influence of sulphuric acid and oxidising substances, should also be seen; while, lastly, as a very delicate reaction, the author quotes that, with chloride of gold, strychnia (in solution) yields immediately a crystalline precipitate, which, although slowly, is yet formed in solutions containing 1-10th of a milligrm. of the alkaloid. This precipitate, and that formed by chlorine, are at once dissolved by concentrated sulphuric acid, and, chromic acid being added, the well-known blue colouration that strychnia yields with this last reagent is produced. The presence of alcohol in liquids to be tested for strychnia should be avoided.

This number contains an excellent biography and review of the scientific labours of the late *savant*, G. Guibourt.

Pharmaceutische Zeitschrift für Russland, No. 17, 1871.

This number contains the following original paper:—

Gallic-Acid Ethers.—F. Ernst and C. Zwenger.—This lengthy and exhaustive essay treats on the mode of preparation and properties and combinations of gallic-acid-ethyl-ether—

$$C_6H_2\left\{\begin{matrix}(OH)_2\\CO.O(C_2H_5)\end{matrix}\right. + 2\tfrac{1}{2}H_2O,$$

a solid crystalline body, soluble in warm water, and readily so in alcohol and ether; when rapidly heated, the crystals fuse at 90° in their water of crystallisation; at a higher temperature, this ether is partly volatile without decomposition. Gallic-acid-methyl-ether and gallic-acid-amyl-ether are also described at length; in some respects these ethers resemble gallic acid in their behaviour with reagents.

No. 18, 1871.

The only original paper contained in this number is—

Essay on the Condition of the Water of Infiltration of the City of St. Petersburg.—Dr. J. Erichsen.—The first instalment of a monograph on this subject, which is, however, chiefly of local interest.

No. 19, 1871.

This number contains the following papers:—

Continuation and End of the Essay on the Condition of the Water of Infiltration of the City of St. Petersburg.—Dr. J. Erichsen.

Contribution to the History of the so-called Theory of Types [illegible].—Dr. Wittstein.

No. 20, 1871.

This number does not contain any original papers.

No. 21, 1871.

This number contains the first instalment of an essay—

Fruit of the Vanilla Planifolia and its Constituents.—Dr. W. von Lentner.—This portion is devoted to historical notices concerning this fruit and its pharmacognostical characteristics. It appears that vanilla was first known in Europe about the year 1593; Francisco Hernandez is the first author who, while resident in Mexico, the native country of vanilla, mentions this substance, under the barbaric name of *Tlilxochitl*; the present name of vanilla is derived from the Spanish *bayna* pod, botanically *siliqua*, diminutive of bayna is baynilla. This portion of the author's essay also contains a very complete and valuable record of the cultivation of this orchidaceous plant and its dispersion throughout the hothouses of European botanical and other gardens.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, November, 1871.

This number does not contain any original papers relating to chemistry.

NOTES AND QUERIES.

Asbestos Cloth—Loss of Mercury.—(Reply to C. T. Kingzett).—Asbestos cloth is still made to some extent at St. Petersburg, and it is very likely that Captain Shaw, the Chief Superintendent of the Metropolitan Fire-Brigade, will be able to inform you where it may be bought in London. As to the fact that sodic chloride acts upon and dissolves mercury, there can be no doubt of it; silver is likewise attacked by common salt, and for that reason silver or electro-plated salt-cellars and salt-spoons are gilt inside, pure gold not being acted upon by common salt, nor is platinum, which is occasionally used, at least abroad, to make salt-spoons.

MEETINGS FOR THE WEEK.

MONDAY, Feb. 19th.—Medical, 8.
—— Anthropological, 8.
—— London Institution, 4. Prof. Odling, F.R.S., "On Elementary Chemistry."
TUESDAY, 20th.—Royal Institution, 3. Dr. W. Rutherford, F.R.S.E., "On the Circulatory and Nervous Systems."
—— Civil Engineers, 8.
—— Zoological, 9.
WEDNESDAY, 21st.—Society of Arts, 8.
—— Meteorological, 7.
—— Geological, 8.
THURSDAY, 22nd.—Royal, 8.30.
—— Royal Society Club, 6.
—— London Institution, 7.30.
—— Royal Institution, 3. Prof. Odling, F.R.S., "On the Chemistry of Alkalies and Alkali Manufacture."
FRIDAY, 23rd.—Royal Institution, 9. Mr. H. Leslie, on "Social Influence of Music."
—— Quekett Microscopical Club, 8.
SATURDAY, 24th.—Royal Institution, 3. Mr. Wm. B. Donne, "On the Theatre in Shakespeare's Time."

TO CORRESPONDENTS.

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J. B. G.—A book on the subject is in the press; it will be duly announced in our columns.

G. C.—By the addition of alcohol 1 part of sulphate of lime is soluble in about 400 parts of water, but it is insoluble in dilute spirits.

A. D.—Yeates, 39, King's Square, Goswell Road.

J. H. St. P.—The following are useful works on the refining of petroleum:—"Handbuch der Photogen und Paraffin Fabrikation aus Torf, Braunkohle, und Bitiminösene Schiefer," von E. Uhlenhuth; Quedlinburg, 1858. "Die Industrie der Mineralöle des Petroleums, Paraffins, und der Harze," von H. Perutz; Wien, 1868. "Coal, Petroleum, and other Distilled Oils," by A. Gesner; London: Baillière. "The Manufacture of Photogenic or Hydrocarbon Oils from Coal and other Bituminous Substances, &c.," by Dr. T. Antisell; New York: Appleton. Mr. Bancroft refines oils for machinery and lubricating purposes generally by agitating them with a lye of caustic soda 1·2 sp. gr.; a sufficient quantity has been added if, after standing, a portion begins to settle down clear at the bottom. About 4 to 8 per cent of the soda solution is commonly required for lard and olive oil; after standing for twenty-four hours, the clear supernatant oil is decanted from the soapy sediment and filtered.

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THE CHEMICAL NEWS.

Vol. XXV. No. 639.

NOTE ON THE SOLUBILITY OF GOLD, AND THE STABILITY OF AURIC NITRATE AND SULPHATE.

By ALFRED H. ALLEN, F.C.S.

Reynolds, in the Chemical News of 1864 (vol. x., p. 48), called attention to the solubility of gold in a mixture of strong nitric and sulphuric acids, with production of a yellow liquid, which turned purple on addition of water and gave a precipitate of metallic gold, no metal remaining in solution.

I have tried the effect of solid permanganate of potassium and concentrated sulphuric acid on gold. The precipitated metal was heated with the oxidising agent for a few minutes till the solution became nearly clear, and the evolution of gas had ceased. The mixture was allowed to cool, and was then poured into water, which turned pink, owing to the presence of a small quantity of undecomposed permanganate or manganic sulphate. On testing with oxalic acid or ferrous sulphate, the solution was found to contain abundance of gold. The permanganate used was pure and free from any trace of chloride, so that the gold in this solution must have existed as sulphate.

On making a similar experiment in which nitric acid was substituted for the sulphuric acid, only a minute trace of gold could be detected in the solution.

Platinum was not dissolved when heated with permanganate and sulphuric or nitric acid. This is rather remarkable, as platinum forms well-defined and tolerably stable sulphates, and, when alloyed with silver, is readily dissolved by nitric acid.

I prepared some pure auric oxide by precipitating a solution of gold in aqua regia with considerable excess of magnesia, boiling, washing with hot water till the washings were perfectly free from chloride, dissolving the precipitate in dilute nitric acid, boiling and washing till the water no longer reddened litmus.

The auric oxide so obtained was heated with strong nitric acid, in which it is well-known to be soluble, all authorities stating that dilution causes the complete precipitation of the gold as auric oxide. This I do not find to be the case, a perfectly clear and nearly colourless solution being obtained on dilution, in which the gold must evidently be present as nitrate, as argentic nitrate gives no trace of precipitate, and no other salt radical is present. The solution of auric nitrate answers to the ordinary tests for gold, and is but gradually decomposed, with deposition of auric oxide having the same properties as before. The decomposition is more rapid when the liquid is heated.

On pouring concentrated sulphuric acid over auric oxide a muddy liquid is produced which becomes clear and yellowish on application of gentle heat. Instead of being completely decomposed by dilution, as stated by Gmelin, it either remains perfectly clear or merely gives a purplish precipitate of finely-divided gold. The solution contains auric sulphate and gives the usual reactions of gold with stannous chloride, ferrous sulphate, and oxalic acid, so that the gold is evidently in a state of true solution.

The "sulphate of auric oxide," described in Gmelin's "Chemistry," and prepared in the above way, is said to be completely decomposed on dilution, with precipitation of the whole of the gold as auric oxide. I have not found this to be the case, solutions of auric sulphate depositing but very gradually a portion of the gold as a dark precipitate soluble in hydrochloric acid, but the decomposition never seems to be complete, and, in some instances, is very slight.

I am inclined to differ from Reynolds and Spiller,* who concluded that the solution of gold obtained by heating the metal with sulphuric and nitric acids did not contain auric sulphate. The real cause of the purple colouration produced by dilution of the acid liquid is, undoubtedly, the reduction of the metal by a lower oxide of nitrogen (probably nitrous acid), produced by the action of the gold and heat on the nitric acid employed. This is proved by the fact that when the water used for dilution is coloured pink by permanganate, little or no precipitation occurs, the nitrous acid being oxidised by the permanganate before the former can effect the reduction of the gold.

This may be further demonstrated by adding a small fragment of ammonium sulphate to the concentrated acid liquid, and again boiling, when the nitrous acid is destroyed, no purple colouration is produced by dilution, and the solution is not distinguishable from the auric sulphate obtained by solution of auric oxide in acid, or by boiling gold with sulphuric acid and permanganate. On adding to any of the liquids a few drops of fuming nitric acid, the gold is thrown down as a purple precipitate, which shows that nitrous acid is competent to produce the effect. This reaction also occurs when fuming nitric acid is added to a solution containing auric nitrate.

Solutions of auric sulphate containing also sulphate of sodium, ammonium, or manganese, appear to possess greater stability than those of the pure salt, but I have not succeeded in obtaining any definite double sulphate.

The above experiments show that gold is more readily oxidised in the wet way than is generally supposed, and that the nitrate and sulphate possess far greater stability than they have received credit for.

Sheffield, Feb. 16, 1872.

NOTE ON THE DOCIMASTIC ASSAYING OF BISMUTH ORES, AND ON THE DOCIMASTIC SEPARATION OF BISMUTH FROM COPPER, FROM ARSENIC, FROM ANTIMONY, AND FROM LEAD.

By HUGO TAMM.

Chemically, and one might almost add commercially, bismuth is one of the precious metals. It is the least precious of all, but its metallurgy, like that of its congener, is of the simplest description, amounting as it has done for a long while, to the mere process of running the metal out of its matrix, since as is the case with precious metals, native bismuth has been the chief source of the commercial product. But this ever limited source is becoming well nigh exhausted, whilst the demand for this metal, and especially for the metal in a great state of purity, is increasing every day. It has thus become an imperious necessity to look for fresh fields of exploration, for new deposits, and as bismuth ores of every description mixed up with other ores of various kinds are now used for the extraction of bismuth, the metallurgy of this metal has somewhat lost of its former simplicity, and in order to overcome the difficulties introduced with the new ores, new reactions or fresh applications of known reaction have been found indispensable.

I have, I think, done more than any other metallurgist towards bringing to perfection both the extracting and the refining of bismuth, especially in a docimastic point of view, for, until then, those two chief parts of the metallurgy of bismuth were almost as much of the nature of mechanical operations as of chemical reactions.

I shall divide my subject into two parts—

* Chemical News, vol. x., pp. 167, 173, 277.

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1. The extracting or assaying of bismuth. 2. The refining of crude bismuth.

1. *Extracting or Assaying of Bismuth.*

Whenever the ore to be tried or run down is of a simple nature, is free from admixture with other ores, and contains bismuth in the metallic state, or in the state of sulphuret, of oxide, or of carbonate, or, as sometimes occurs, consists of a mixture of oxide, carbonate, subsulphate, and oxychloride, the extracting or assaying of bismuth is reduced to the very simple operation of mixing the ore with as fusible a flux as can easily be obtained, to which a reducing substance, generally charcoal powder, is added in proper quantity.

It is of course useless to lay down particular rules concerning the nature or the quantity of the flux, and of the reducing substance to be employed in this operation; indeed, it is not advisable to do so, and it is by far the best to be guided by the nature of the materials at hand, and by the results of a few trials with varied proportions of flux and of the reducing agent; the aim of the assayer or of the metallurgist being the highest amount of metal that can be obtained in a given instance. Still, one of the best fluxes, as well as one of the most simple, consists of a mixture of two parts of carbonate of potash or soda, and one part of chloride of sodium, to which a proper amount of red argol or of cyanide of potassium on the small scale, and powdered charcoal on the large scale, are added. There is absolutely nothing new or important connected with this operation, and there is no reason to presume that it will ever be deeply modified.

2. *Extracting or Assaying of Bismuth in Ores containing a large amount of Copper.*

The problem of the direct separation of bismuth from ores containing large proportions of copper was one of great difficulty, and its solution, which was of great importance, offered great interest. The difficulty consisted chiefly in the fact that both copper and bismuth behave, in nearly every instance, in an identical manner with docimastic reagents; but I have very happily hit upon a most simple and practical means of effecting the direct separation of those two metals.

The chief kinds of ores containing both bismuth and copper are the bismuth copper pyrites or sulphuretted ores, and the double oxides or carbonates of bismuth and copper, or oxidated ores.

Both kinds of ores may be, and generally are, contaminated with other metals, but these foreign metals constitute only, as a rule, a small fraction of the whole, and the problem of their elimination will be found under the head of Refining.

The reaction upon which the separation of bismuth from copper is founded consists in the fact that, in presence of alkaline fluxes, carbonaceous reagents, and, of course, among them carbon itself, reduce sulphuret of bismuth to the metallic state, while sulphuret of copper is not reduced.

In the treatment of sulphuretted ores, both metals being already in the state of sulphurets, all that is required is to run them down with a mixture of carbonate of potash or soda and salt, to which a little flowers of sulphur or ground sulphur and charcoal or any other carbonaceous substance is added.

In this operation metallic bismuth is extracted quite easily, and the metal thus obtained is tolerably free from copper. It is recommended to add a little sulphur in order to ensure a complete sulphurisation of copper during the whole of the operation, and especially to prevent any desulphurisation of copper by the alkali, and, consequently, to prevent, as much as possible, this metal from being reduced.

With oxidated ores the operation is very similar in every respect to the one just described, and it differs from it only by the amount of sulphur used, which is greater in this instance since the whole of the metals have to be *sulphurised.*

Three parts of the ore are mixed with from two to three parts of a flux composed of:—

Carbonate of soda	5 parts
Salt	2 ,,
Sulphur	2 ,,
Charcoal powder	1 ,,

Both the composition of the flux and the amount to be used may be altered with advantage to suit each particular case. A few synthetical trials, in the hands of a person accustomed to docimastic or metallurgical operations, are all that are required to make the best use of this reaction.

In general, it is to be observed, that the amount of flux and of reagents required for the assaying may be considerably *reduced* when the operation is carried on on a larger scale. On the other hand, it is scarcely worth while mentioning that, in the operation of assaying, cyanide of potassium forms an admirable substitute for carbon.

During the process of extracting bismuth by means of sulphur and carbon there is a loss of about 8 per cent of the bismuth contained in the ore. This loss is unavoidable, but there is a more than proportionate loss of the metals arsenic, antimony, and lead, which, in this operation, are reduced with bismuth, and the crude metal obtained by this process is not so impure as the corresponding metal obtained by the direct reduction of the oxidated ores; besides, the whole of the copper remains in the slag.

Whenever the sulphur-carbon process is employed, the use of iron stirrers must be carefully avoided, for the reason that sulphuret of copper is rapidly reduced to the metallic state by this metal, especially in presence of alkalies.

The problem of the docimastic separation of bismuth from copper, certainly one of the most difficult that metallurgy could offer, has thus been solved in the most simple manner.

The introduction of sulphur as a direct docimastic reagent in metallurgical operations will be, I trust, a new era in that branch of industry. The facility with which a difficult problem has been solved by its use may lead to the most sanguine expectations, and to give an idea of its probable future importance, I will quote an instance little known, and which, although not bearing directly on the present subject, is derived from it.

When an alloy of lead and antimony is sulphurised by the direct action of sulphur at a red heat, contrary to all anticipation, lead is gradually sulphurised first, and, after a while, a layer of metallic antimony, tolerably free from lead, is found under a layer of sulphuret of lead tolerably free from sulphuret of antimony. This fact is really very remarkable, the more so that lead and antimony, which may differ essentially in a docimastic point of view, when separated, behave in a nearly identical manner when once alloyed.

The process which I propose for the separation of bismuth from copper will be found chiefly useful and important for the separation of bismuth in minerals containing large quantities of copper. When, on the contrary, this metal exists only in smaller proportions, it is more advantageous to run down the whole of the metals, and to separate them afterwards in the special operations of refining. But I should recommend the sulphur-carbon process for the treatment of the somewhat abundant ores of bismuth formed of oxides of bismuth and lead, and small proportions of arsenious acid and antimonious acid, with a little oxide of copper; for there is as yet no direct means of smelting pure bismuth from ores containing large proportions of lead, but it has been observed that bismuth extracted by the sulphur process contains less lead than the corresponding metal obtained direct from the oxidated ore. The same remark applies to arsenic and antimony, and this is in accordance with the behaviour of the sulphurets of these metals with alkaline sulphurets.

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Docimastic Refining of Crude Bismuth.

The various ores of bismuth which I have described, whether sulphuretted or oxidated, are seldom formed of bismuth and iron only, or of only bismuth, copper, and iron. They nearly always are contaminated by various proportions of lead, of arsenic, of antimony, metals which are reduced with bismuth, partially, at least, whatever process has been used for the extraction of bismuth, and, besides, the metal obtained by the sulphur process from copper-bismuth ores still contains a small quantity of copper, which it is important to remove.

Bismuth extracted by any process is so generally free from iron that no notice need be taken of this metal, which remains wholly in the slags.

The fracture of good bismuth and that of its various alloys is so characteristic that it is not often necessary to have recourse to tests in order to determine what particular processes will have to be used for the refining of the crude metal.

Pure bismuth is tougher than most of its alloys. Its fracture is bright, and it possesses a fine reddish colour. Bismuth containing arsenic gives a beautiful fracture, consisting of large laminæ of a whiter colour than that of pure bismuth. Copper mixes with bismuth without alloying with it, and is almost always discernible. The fracture of bismuth containing antimony is dull and is mostly composed of very small crystals. Lead does not prevent bismuth from crystallising in large crystals, but these crystals are studded all over with fine crystals. Sulphur imparts a black tinge to metallic bismuth.

To these appearances, which almost suffice to an experienced eye, may be added a few simple tests.

It is difficult to detect arsenic in presence of a large quantity of bismuth by means of reagents, and the most simple way of detecting this substance is to heat the bismuth on charcoal, with the oxidising flame of the blowpipe. Very small quantities of arsenic may be detected in this way.

To detect copper, the metal is dissolved in nitric acid, the solution is supersaturated by ammonia, and filtered. The blue colour of the filtrate indicates the presence of copper.

When bismuth dissolves in strong nitric acid, with formation of a cloudy white precipitate which does not disappear on addition of water, it is because antimony is present.

When bismuth dissolves in strong nitric acid, with formation of a very white granular or crystalline precipitate which dissolves freely on addition of water, this indicates the presence of lead.

But to detect with absolute certainty the presence of even very small proportions of lead, the metal is dissolved in nitric acid. The solution is supersaturated by ammonia, and re-acidulated with the smallest amount of hydrochloric acid which will give a clear liquor. This liquor is then precipitated by a large excess of boiling water. Water must be added until no further precipitation takes place. The whole is then filtered, and the filtrate is saturated by a mixture of ammonia and carbonate of ammonia; when a yellowish-white precipitate is formed it is because lead exists in the bismuth.

It may be useful to submit the metal to be refined to these various tests in order to ascertain beforehand which refining process should be used. But it is essential to apply each test to the refined metal, so as to verify its degree of purity.

(To be continued).

ANOMALOUS PRODUCTION OF OZONE.

By HENRY H. CROFT,
Professor of Chemistry, University College, Toronto.

About six years ago, when evaporating some syrupy iodic acid, prepared according to Millon's process, over sulphuric acid, I noticed that when the acid began to crystallise, the air in the jar (covering the drying dish) had a strong smell of ozone, or active oxygen. A couple of years afterwards, on again making iodic acid, this observation recurred to my mind, and I carefully tested the air in the jar during the evaporation; no trace of ozone could be detected until the acid began to crystallise, when the smell of ozone became immediately perceptible, and all the usual tests for that body succeeded perfectly.

During the last month I have had occasion to convert 2 ozs. of iodine into iodic acid, and exactly the same result has been observed. The acid usually solidifies to opaque verrucose masses; but on this occasion the crystals formed were clear and brilliant. The solution had in this, as in all the former cases, been boiled down to thin syrup, so that no trace of chlorine or nitric acid could possibly have remained to act on the ozone paper. The air in the jar was tested from day to day, both by the smell and the action of iodised starch paper. Even when a few crystals began to form no change was noticed, but when the crystallisation set in fully the evolution of ozone was most remarkable, the strong smell being quite characteristic, entirely different from that of chlorine or nitric acid.

I am quite unable to account for this ozonification of the air (or oxygen) over crystallising iodic acid. My friend Mr. Storry Hunt has suggested that it may arise from a partial deoxidation similar to that which produces ozone when hypermanganates are decomposed, as observed by him and other chemists. As the crystallising acid remains perfectly white, either opaque or transparent, and as the lower oxides of iodine are of a yellow, or even brown colour, according to Millon, I cannot accept this explanation, and even if it were true, the phenomenon would be equally unintelligible—a reduction taking place during crystallisation. I can offer no explanation of the simple fact that air over crystallising pure iodic acid becomes ozonised, but I think that the observation seems to offer a wide field for further experiments, which I have, unfortunately, not the time to carry out.

ON THE DIFFUSION OF MERCURIAL VAPOURS.

By M. MERGET.

From the facts given in a former portion of this paper, quoted in abstract in our "Chemical Notices" a few weeks ago, a great number of applications may be deduced, of which some of the most important are the following:—

I observe, in the first place, that, as regards analytical chemistry, the ammoniacal nitrate of silver test-paper becomes a very sensitive and precise reagent for the detection of mercury. We are all acquainted with the test whereby a piece of bright metallic copper or gold, by electro-chemical action, is employed for the detection of mercury, which, by forming a white-coloured amalgam with the copper and gold, and by the volatilisation of the mercury by the application of heat, is readily recognised; but if the liquor thus tested for mercury does not contain a rather large quantity of mercury, this test is not sufficiently decisive. In such a case, when they cannot distinguish the formation of an amalgam, it is only necessary to bring the piece of gold or copper into contact with ammoniacal nitrate of silver paper for the purpose of obtaining a brown colouration, which characteristically indicates the presence of mercury. By operating in this manner, I have been able to demonstrate the presence of mercury in a solution containing 1-100,000th part of bichloride. When mercury is set free and volatilised in the dry way, it is usually seen in the shape of very small globules, only visible by the aid of a magnifying glass; but when the quantity of mercury is very small, these globules may happen to be altogether in-

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visible. The smallest trace of vapours of mercury, absolutely too small to cause any perceptibly visible deposit of globules, is immediately rendered apparent by their action upon the test-paper just alluded to. Reciprocally, vapours of mercury may be usefully applied for the detection of the salts of the noble metals, by the deep colours the solutions of these salts imparted to paper assume by being exposed to the vapours of mercury. The solutions of the salts of platinum and iridium may be used to write with a pen or paint with a camel's-hair brush on paper, or on other substances which do not chemically alter and affect the composition of these salts; and what is so produced on paper will, after having been exposed to the mercurial vapours, be almost indestructible by all chemical reagents. The combined application, therefore, of these salts, and of the vapours of mercury, yield scope for the making of indelible inks suited for writing or making drawings on paper, linen, wood, &c. Made up with salts of gold, palladium, and silver, these inks, though less unalterable, may be, however, advantageously employed in many instances in the same manner. Instead of using the solutions of these salts as writing ink, the solutions may be painted in thin films over ordinary paper, and this next exposed to the vapours of mercury evolved from previously mercurised figures or drawings. I have thus succeeded in solving the problem of photographic printing without light. For this purpose, I first prepare a positive (on glass or paper) so that it is thoroughly impregnated with mercurial vapours, condensed and absorbed by finely-divided reduced silver, these vapours being evolved when the positive is pressed against a piece of paper sensitivised with the solution of a salt of any of the precious metals. The proofs thus printed, supposing a silver salt to have been used, are fixed by the processes in use in photography; when salts of gold, palladium, platinum, or iridium have been used, the fixing of the print is obtained by simply washing with water—leaving the prints for ever absolutely unalterable by light and all atmospheric action, while, moreover, the prints produced by reduced platinum or iridium are indelible and cannot be destroyed without the aid of chemical agents, which would also destroy, or at least entirely alter, the paper on which the prints are made. It is clear that steel and copper and photo-chemical engravings may be treated in a similar way.

The permeability of mercurial vapours through porous substances has enabled me to take upon sensitised paper the impressions of leaves and twigs of plants, which are thus reproduced with great neatness and correctly resemble the original. As regards the detection of mercurial vapours and the presence of mercury in toxicological researches, my discovery of the tests alluded to is of great value. As an instance of the value of these tests, I may here quote that, on visiting a looking-glass factory very well constructed as regards ventilation in every respect, I found the air of this very large establishment saturated from top to bottom with mercurial vapours.

In the discussion which followed the reading of this paper, Professor Boussingault observed that sulphur evolves, in the presence of mercurial vapours, also vapours which neutralise very completely the deleterious effect of the vapours of mercury on the human system.

ON SUPERSATURATED SOLUTIONS OF SODIC CHLORIDE.

L. C. de COPPET, Ph.D.

It was noticed by Blagden, as early as 1788, that solutions of sodic chloride, when cooled below 0° C., are liable to become supersaturated. More recently, Schroeder* prepared supersaturated solution of this salt by cooling to −10° C., in closed vessels, strong solutions prepared by heating. These were previously filtered and heated to boiling in order to remove or dissolve any particles of solid salt which might remain in suspension in the liquid, and prevent, as Schroeder believed, the supersaturation.

I have seen a solution of sodic chloride become supersaturated under the following circumstances:—A solution, saturated by heating, was cooled by means of a strong freezing mixture in an open vessel freely exposed to the nuclear action of the dust floating in the atmosphere; a large excess of ordinary anhydrous sodic chloride was added to the solution, which was continuously stirred with a thermometer. Salt deposited from the solution during the early part of the cooling, but I do not know whether this deposition continued after the temperature had sunk below 0° C. The temperature was still several degrees above the freezing-point of the normally saturated solution (about −21·5° C.) when the liquid suddenly crystallised, forming, together with the excess of salt previously alluded to, a solid mass of such compactness that the thermometer could only be withdrawn with difficulty. This freshly formed crystalline mass consisted very probably of the hydrate, $NaCl,2H_2O$.

It is known that, at ordinary temperatures, the monoclinic crystals of $NaCl,2H_2O$ soon fall to pieces, being converted into minute cubes of the ordinary anhydrous salt and water; this decomposition takes place immediately if the crystals of the hydrate are brought in contact with the smallest particle of ordinary sodic chloride.

It would appear, however, from the experiment just described, that at temperatures inferior to 0° C., the hydrate, $NaCl,2H_2O$, is not decomposed by contact with the ordinary anhydrous salt. In any case, the experiment shows that the presence of the ordinary salt does not prevent supersaturation, and that it is not indispensable either to filter or to cool the solution in a closed vessel.

In order to compare the strength of the supersaturated solution with that of the mother-liquor after crystallisation, I cooled a solution of sodic chloride, saturated near 100° C., in a flask loosely stopped with cotton-wool. The flask was first placed in cold water, then in a freezing mixture at −14° C. During the first part of the cooling process, cubic crystals, due no doubt to evaporation, formed at the surface of the liquid, but sank to the bottom of the flask when this was shaken. A thermometer, immersed in the solution, had been marking −14·0° C. for some minutes, when a portion of the perfectly clear menstruum was poured into a previously weighed flask provided with a cork, and used to determine the strength of the supersaturated solution. A few minutes later a quantity of transparent crystals formed suddenly, as well as I could judge, in all parts of the liquid simultaneously, and the thermometer rose rapidly from −14° to −11·5° C., and then fell slowly back to −14°. A little later still, the solution in the weighed flask also crystallised, though its temperature must, in the meantime, have risen considerably. A sufficient time having elapsed for the newly-formed crystals to subside, a second perfectly clear portion of the menstruum was poured into another vessel of ascertained weight; then the flask was placed in melting ice and shaken from time time. After the thermometer in the solution had stood for two hours at 0° C., a third portion of the liquid was poured off and the strength of the solution in the three weighed flasks estimated. The determinations showed that the solution contained, in 100 parts of water, of anhydrous sodic chloride,

36·4	parts at	−14° C.	before the sudden crystallisation
32·5	,,	−14° C.	after ,, ,,
35·7	,,	0° C.	,, ,, ,,

According to Poggiale, a saturated solution of sodic chloride contains 32·7 parts of NaCl at −15° C., and 35·5 parts at 0°. The number given by Mulder* for the solubility at 0° C. is 35·7, the same as I found. It will be seen that all these numbers express the solubility of the

* *Annalen der Chemie und Pharmacie*, t. 109, p. 46.

* "Scheikundige Verhandelingen, doerde deel, derde stuk, p. 37. Rotterdam. 1864.

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hydrated sodic chloride, and not that of the anhydrous salt. A solution containing 36·4 parts of NaCl in 100 water is normally saturated with the anhydrous salt at about +35° C.

The facility with which solutions of sodic chloride are liable to become "supersaturated" explains how certain investigators were led to believe that the solubility of this salt was the same at all temperatures, and how others again believed it to be greater at 0° C. than at ordinary temperatures.

NOTES OF

DEMONSTRATIONS ON PHYSIOLOGICAL CHEMISTRY AT ST. GEORGE'S HOSPITAL.

By S. W. MOORE.

XI.

MILK is secreted by the mammary gland and serves for the nourishment of the young animal; the presence of this gland distinguishes the class Mammalia.

This secretion necessarily contains all material for the building up of the body; these are definitely—casein, the albuminous principle; butter, the fatty body; lactose, the sugar; and certain salts. The milk secreted immediately after parturition is named colostrum; it contains albumen in large quantities, which coagulates on boiling, it acts by purging the child: after this has passed away the true milk is secreted; this in most animals, as the cow, horse, &c., is white, but in the human female is much clearer. When viewed by the microscope, it appears as a clear fluid containing innumerable corpuscles in suspension; these are fat enclosed in a casein capsule.

The sp. gr. of milk it is needless to quote, for though great stress has been laid on it as a test for the percentage of water, yet it is of no avail, a milk rich in butter would give a bad result with the lactometer test, whilst skimmed milk, from the absence of butter, would give a good result, though really not so good.

Fresh milk is alkaline and contains the following percentage composition (L'Heretier).

Water..		867·8
Solids—		
Butter	42·5	
Casein	11·7	
Sugar	74·0	
Salts	4·0	
	——	132·2
		1000·0

Any considerable deviation from these numbers in human milk may be rejected.

So frequently do changes occur in this fluid from some abnormal condition of the mother that, in many cases of disease in children, the cause may be traced to the mother's milk; apart from direct disease foreign bodies may be secreted with it, as iodine, strychnine, &c., the quantity being such as to have no effect on the mother, but yet proving fatal to the child. In infantile disease the physician should make it an invariable rule, when no other cause is to be found, to examine clinically the milk of which the child partakes, when, in a majority of cases, he will find his trouble repaid and his diagnosis assisted.

The process I adopt is as follows:—

Take a measured quantity of milk, and evaporate to dryness on a water-bath, break the dried mass into fragments, and boil with a small quantity of benzol; this extracts the butter, which can be weighed after the benzol has been allowed to evaporate. The dried mass, now freed from butter, may be boiled in alcohol, which removes the casein; this can be weighed also when freed from alcohol. The residue now left may be incinerated for salts, and tested in the ordinary way for phosphates; the sugar may be estimated by the copper test on a fresh portion of milk.

Cows' milk contains more casein and less sugar than human milk; therefore, when used as food for children, it should be diluted with a third water, and a few grains of lactose added for every ounce of milk.

The adulterations of milk are few, water being the chief addition; the casein should amount to 3 per cent in ordinary cows' milk.

An excellent form of pure milk is the Anglo-Swiss condensed milk: pure milk is evaporated to the consistency of treacle, and sugar added; this addition keeps the preparation admirably, a sample exposed for three months under my observation had not appreciably changed at the end of that time.

A DELICATE TEST FOR NITRIC ACID IN WATER.*

By EDWARD NICHOLSON,

Assistant Surgeon R. A., Analyst of Waters Mysore, Ceded, and Northern Districts.

THE sulphate of iron test for nitric acid is uncertain when the quantity is less than 1 in 100,000, and requires considerable care in order to ensure uniformity of results. I have, therefore, tried the degree of delicacy of the brucine test.

This, as recommended by Kersting (*Ann. der Chem. u. Pharm.*, 1863), is used in much the same way as the sulphate of iron test. To 1 c.c. of the water in a small test-tube, add 1 c.c. of an aqueous solution of brucine containing one part in a thousand (which is about the extent of solubility of the alkaloid); then, by a thin pipette, send a few drops of pure sulphuric acid down to the bottom of the tube. If nitric acid is present, a pink zone will appear at the junction of the two liquids, turning yellow before it disappears.

Dr. Parkes, in his "Manual of Hygiene," says that water containing 1-100oth of nitric acid shows this reaction very decidedly; but I find that this is not the limit of sensitiveness, as water containing 1-10,000th, that is, 0·100 grm. of HNO_3 per litre, shows the reaction distinctly; it comes on in about a minute, and lasts for half an hour. Weaker solutions fail to show the reaction; 1-20,000th does not show it.

I have, however, found a much more delicate way of applying the test.

The solution of nitrate of potash used in the above experiment, containing 0·100 grm. of nitric acid per litre, was diluted with 10, 100, and 1000, and 10,000 parts of a water of ordinary composition, containing 0·200 per litre of carbonate of lime and chloride of sodium, and free from nitric or nitrous acids. Each dilution was tested by evaporation of 1 c.c. to dryness in a porcelain dish; the residue was moistened with two small drops of pure and strong sulphuric acid, and a minute fragment of brucine, about the size of a pin's head, dropped in and moved about with a fine glass point.

The original solution gave a blood-red colour, fading to orange.

The first dilution, containing 0·010 of nitric acid per litre, gave a deep pink colour over the whole surface.

The second dilution, containing 0·001 (one part in a million) gave the reaction very decidedly, a fine rose colour following the brucine as it was moved about.

The third dilution, containing 1-10th milligramme per litre, gave a distinct rose colour round the brucine.

The fourth dilution, containing 1-100th milligramme per litre, gave a rose colour to the fragment of brucine. Beyond this point it was difficult to find reagents not giving a faint trace of colour to the brucine.

* From the *Madras Monthly Journal of Medical Science* for May, 1871.

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it over red-hot charcoal obtained from pure sucrose mixed with potassic carbonate. The compound obtained was potassic cyanide. Bunsen repeated and confirmed the experiments; and soon after his results were published two Frenchmen started an establishment at Grenelle, near Paris, for the purpose of producing cyanides on a great scale. They did not succeed in making the undertaking pay, nor did they succeed when they afterwards attempted it in England. Other experiments were tried upon a large scale with the view of manufacturing potassic ferrocyanide without animal matter, for which the nitrogen of the air was the substitute. Alkalised charcoal was used as in the former experiments. This undertaking was also abandoned after the loss of many thousands of pounds. Other manufacturing attempts were subsequently made, and they were so unsuccessful that it was suspected that the ammonia of the atmosphere or the nitrogenous constituents of the coal, rather than free nitrogen, formed the source of the cyanogen; and a process was proposed and patented for the manufacture of ferrocyanides by passing the gases evolved during the carbonisation of animal matter over alkalised carbon at a red heat. The ammonia in this instance was partially converted into ammonic cyanide and marsh gas. Dr. Lunge, who worked this process on the manufacturing scale, found acetylene among the waste gases in marked quantity. The ammonic cyanide was passed into ferrous sulphate solution, and the precipitate, treated with potassic carbonate, yielded the desired ferrocyanide. This is a manageable method of procuring cyanides, and might be used with advantage if ammonia could be cheaply obtained. The author referred to the advantages and disadvantages, respectively, of using potash and soda in these experiments, and suggested baryta for use instead, as its cyanide is formed at a low temperature, the base is infusible and non-volatile, and it can be procured in any quantity. After speaking of other methods, including that of Schwartz, which involves the use of copper or iron filings exposed at a red heat to the action of a current of carbon disulphide and ammonia gases, he referred to the production of alkaline cyanides in blast-furnaces using raw coal and the hot blast, embracing a notice of the observations and experiments of Dawes, Zinken and Bromeis, Redtenbacher, and Bunsen and Playfair. At the Portland Ironworks, near Kilmarnock, one of the furnaces, in the year 1865, produced for some time upwards of half a ton weekly of a saline mass containing cyanogen from leaks in the neighbourhood of the tuyeres. Some specimens were of great beauty, being invariably pure white mottled with pink-coloured veins. One botryoidal mass weighed upwards of 50 lbs., and was secured for the Pharmaceutical Society's Museum in London. The air around the tuyeres was impregnated with the odour of the cyanide. None of the other furnaces produced the compound, and the one in question, on being blown out and repaired, also ceased to do so. Mr. Smith analysed many specimens of these furnace products at the time, and found them to contain from 3 to 19 per cent of cyanogen; and what seemed new to him was the presence of lithia in weighable quantity, as much as 0·75 per cent being got from one specimen, of which the following is an analysis:—

Potassic cyanate	21·45
,, carbonate	1·34
,, silicate	0·98
,, sulphate	0·41
,, cyanide	47·73
,, sulphide	1·61
,, chloride	0·74
Potassa	10·13
Soda	7·19
Lithia	0·74
Graphite	4·50
Insoluble residue, fixed at low red heat	1·32
	98·14

Graphite, the author remarked, is generally present in these blast-furnace cyanides, and is probably a product of the decomposition of the cyanogen itself, and probably, also, is the graphitoidal carbon which separates so plentifully in scales from certain kinds of pig-iron while cooling and becoming solid. Another remarkable cyanide occurring in blast-furnaces is that of titanium, found in the hearth in the shape of beautiful copper-coloured cubes, which were proved by Wöhler to be titanium cyanide and nitride. Some Irish iron ores contain as much as 10 per cent of titanic acid, and from the remarkable power which the metal possesses of absorbing and combining with nitrogen some special *rôle* seems provided for it in the chemistry of the future. The preparation of ammonia and cyanogen salts may be said to go hand in hand, so intimately related are the two classes of compounds. Those of cyanogen so easily yield ammonia, and ammonia within certain limits is so easily transformed into compounds of cyanogen, that every improvement in the preparation of the one class of compounds must exert a marked influence on that of the other. No method of forming ammonia from its elements has yet been turned to practical account. It is detected in the collected products resulting from the combustion of phosphorus, carbon, metals, &c. Many cyanides are decomposed when superheated steam is passed over them, ammonia being one of the products. Barium cyanide especially is very easily acted on in this way; all its nitrogen is given off as ammonia, and baric carbonate is left behind. Beet-root residues yield salts containing sometimes as much as 1½ per cent of cyanides. Referring to the varied applications of ammonia and its compounds, and to the rapidly increasing use of the sulphate in agriculture, the author devoted some consideration to the question of returning the nitrogen to the earth which is removed from it in the form of food, and stated that all the present supplies of ammonia are, or may be said to be, procured by the destructive distillation of animal or vegetable substances, as in the production of bone charcoal for the sugar refiner, and in the distillation of coal and shale in the manufacture of coal-gas and paraffin oil. Of late years, the production of gas tar has relatively diminished, while that of ammonia has relatively increased, and the methods of recovering it have been improved. The high temperatures now employed in gas making transform most of the nitrogen of the coal into ammonia, instead of converting it in considerable quantity into compounds of the pyridine and related series, as when very low temperatures were employed. A large quantity of ammonium carbonate and ammonium cyanide might be obtained from the vitriol tar of the mineral works if it were properly treated; and ammoniacal liquor of much greater strength might be obtained by gas managers if they were to wash the gas more thoroughly. By using the liquor as a shower, in the proportion of 1 vol. to 18 of gas, the liquor might easily be raised to 10° or 11° of Twaddell's hydrometer, while at present the average strength is rarely above 5° as obtained from the gas tanks. Ammonium dicarbonate is the salt present in largest proportion in gas liquor; a saturated solution of it sometimes gets entangled with the heavy tar in the bottoms of the tanks and in the condensers of gas-works. It is difficult or impossible to pump it, and when the tanks are cleaned out (perhaps once a year) tons of it are often got and thrown away by gas managers among the fuel, so little do they know of its value. Even many tar distillers are ignorant of its value, and they often set it down as naphthaline, and consequently of but small account. When the crystals are washed with oil they are ready for saturating with acid. A sample analysed by the author yielded—

Ammonia	20·07
Carbon dioxide	54·21
Water, with tarry matter and some sulphocyanogen (by difference)	25·72
	100·00

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The same salt was noticed by two German chemists, and by them said to be of rare occurrence; but, according to Mr. Smith, it is not at all rare. The hydraulic mains of gas works are not often cleaned, but occasionally an extraordinary deposit of sal-ammoniac is found in them. It is of the fibrous nature of the sublimed compound of commerce. The general method of treating the gas-liquor in Scotland is to pump it into a boiler and distil off the volatile ammonia into sulphuric acid, continuing the operation as long as any strong odour of ammonia clings to the liquor. The spent water is then got rid of as speedily as possible, and the boiler re-filled. This method gives a good light-coloured sulphate with a little free acid and a mere trace of fixed matter on ignition. In some factories the Coffey still is used for continuous distillation, but it has not met with much favour, although, in certain cases, it has been adopted with success. The author also referred to a process for economically recovering sulphur from the sulphides present in gas-liquor, to the presence of ammonium sulphocyanide. This compound has been used for photographic purposes, and the author said that if any demand should arise for it any amount could be got from the spent water of the ammonia works by simply evaporating it and purifying the salt. When heated till decomposition ensues, the remaining residue is the curious substance known as mellon, the chemical history of which requires some clearing up. After all the present demands for this salt are supplied the residue is generally discharged as worthless; even the contained ammonia is but rarely recovered. In the author's opinion there is enough of this compound to produce all the yellow and red prussiates required in the arts. The chief difficulty, at first sight, is the immense volume of water requiring to be evaporated; but with cheap fuel or an abundance of waste heat, this might easily be overcome. The concentrated liquor is evaporated with sufficient potash solution to drive off the ammonia, and recovering it in the usual way. After being completely dried, the saline mass is mixed with iron filings or spongy iron and heated for a short time in a closed iron vessel. The sulphocyanide of ammonium is resolved into potassic ferrocyanide and potassic and ferrous sulphides:—

$$6KCNS + 12Fe = 2[K_2Fe(CN)_3] + K_2S + 5Fe_2S.$$

On treating the mass with water the ferrocyanide dissolves, and may be separated from the ferrous sulphide by filtration; it is afterwards separated from the potassic sulphide by crystallisation, the sulphide remaining in the mother-liquor.

Mr. Smith mentioned that he had been for some time engaged in an attempt to perfect this process, and that the results of his laboratory experiments promised fair.

CORRESPONDENCE.

THE NESSLER TEST.

To the Editor of the Chemical News.

SIR,—A hint, if even a small one, may prove valuable in these busy days, when so many are practically pursuing our beautiful science of chemistry, and when, perhaps, some pursue it "*con amore*" who cannot afford to waste time, and who are mainly dependent upon their own resources and guidance. I have a hint I wish to give concerning Nessler's useful test. Our text-books tell us how to prepare this test, but afford but very slight information as to any precautions that are needful to be observed in its practical use, and in the deductions to be made therefrom. For instance, in the presence of soluble Mg compounds in water or of those of Fe, while they do not prevent, but on the contrary increase, the amount of precipitate produced on the addition of Nessler's test, such precipitate affords no clear data by which we may judge of the presence or absence of ammonia. For instance, magnesium compounds would furnish a white precipitate with Nessler's test by which any red ammonium precipitate produced would be disguised. Ferric compounds would precipitate ferric oxide, and this might be mistaken for the red ammonium compound. Caution should be exercised therefore in using this test, especially in the examination of potable waters, a practice which is becoming daily more needful, and one which is likely alone to resolve the unhealthy condition of many homes and of those who reside in them. Nessler's test is generally resorted to as a means of determining readily the presence or absence of ammonia; we see this cannot be surely depended upon in its reactions unless the deductions made therefrom are framed with due precautions.—I am, &c.,

E. V. GARDNER, F.E.S.

Laboratory, Berners College.

MISCELLANEOUS.

The Repetition of Experiments.—The importance of experimental investigation, so strongly insisted on by Bacon and practised since by scientists as the basis of the true scientific method in physical researches, is now so generally admitted as to need no argument. The importance of not accepting results as final determinations of physical laws until repeated experiments leave no room to doubt their accuracy, is not so generally appreciated. The really scientific investigator always retains some reservation in his acceptance of results attained by others, unless, through the most careful scrutiny, he can find no error in their method of experimentation, and can devise nothing which appears a more sure way of arriving at truth. The prestige of name and attainments goes far to influence belief, but those who think for themselves need a surer foundation than this in matters where accuracy is essential. Libraries of reference contain tables which are relied upon by engineers and constructors in making their computations, and in the use of which they cannot go far astray; yet many of them have been found in practice to be inaccurate. At least, recent experiments have given results differing more or less from those formerly obtained, and from which the tables were framed. As long as differences exist greater than may be accounted for by inaccuracies in manipulation, there must remain doubt as to the correctness of our knowledge. Experiments upon any subject should, then, never cease until a certain degree of uniformity is attained through the employment of different methods. There are not wanting recent illustrations of the truth of this proposition. Among these may be cited the remarkable experiments, of Professor Ogden W. Rood, of Columbia College, New York, on the amount of time necessary for vision, in which Wheatstone's conclusions from his experiments on the duration of the discharge of a Leyden jar, are found to be immensely far from the truth. He affirmed that the time necessary to produce distinct vision was within one-millionth of a second. Professor Rood now shows, by a most ingenious method, that in a space of time less than forty millionths of a second, the retina can receive and combine a whole series of impressions; and he feels confident that the eye could distinctly see an object illuminated during a period so inconceiveably minute as four billionths of a second. In the conclusion of his paper on this subject, published in the *American Journal of Science* for September, 1871, he quietly remarks: "All this is not so wonderful, if we accept the doctrine of undulatory light, for according to it, in four billionths of a second, nearly two and one half millions of the mean undulations of light reach and act on the eye." Professor Rood also has determined the possible duration of the discharge from a Leyden jar to be as short as nineteen hundred-millionths of a second. Even the experiments of Regnault have been recently revised by Mr. Alexand

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Morton, with results from which he deduces formulæ that show the relation between the temperature, pressure, and density of steam. Recent experiments have shown room for doubt as to the full reliability of the tables in common use for computing the strength of beams and girders. Boiler explosions are now being brought under systematic experiment, at Sandy Hook, which will doubtless throw much light on this important subject. In short, there yet remain many things in science and mechanics to be definitely determined. The experiments of General Morin on friction might be revised, we think, with profit, and carried further than he went with them, to show how the compounding of motion on cylindrical surfaces modifies friction, and what part of the power is absorbed by friction in each of the components of the resultant. The use of air compressors has shown that we are far from knowing the real laws of the friction of gases in tubes; and herein is a most important and profitable field of investigation, as the use of air as a motive power in mines and tunnels is only in its infancy. But we have said enough to show that, notwithstanding the labours of those that have gone before, there is yet enough scientific work to be done.—*Scientific American.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, January 29, 1872.

This number contains the following original papers and essays more especially bearing upon chemistry:—

Researches on Fermentation.—E. Fremy.—First portion of an exhaustive memoir on this subject, which has of late given rise to very grave discussions in this scientific assembly. The author's memoir is too lengthy to admit of any useful abstraction.

Observations Relating to the Processes of Preserving and Ameliorating Wine by Heating.—P. Thenard.—The main object of this paper is to prove that Appert is the inventor of this method, and that De Vergnette first made it practically applicable by fixing the limits of temperature to which the wine should be heated.

Note Relating to Researches on Dyeing made by P. Havrez, C.E., at the Professional School at Verviers (Belgium).—Professor Chevreul.—The venerable *savant* gives a detailed account of researches made, whereby the contents of his (Chevreul's) celebrated work ("Moyen de Définir et de Nommer les Couleurs d'Après une Méthode Précise et Expérimentale") have been turned to practical account, while P. Havrez also confirms what was stated to be the case (on August 7, 1826, by Prof. Chevreul), viz., that Prussian-blue becomes deteriorated.

Supersaturation of the Solution of Chloride of Sodium.—L. C. de Coppet.—The original paper has been sent to us by the author, and is given on another page.

Le Moniteur Scientifique Quesneville, No. 361, January, 1872.

This number contains the following original papers and memoirs bearing upon chemistry:—

Anthracen and its Derivatives.—Dr. E. Kopp.—The continuation of this very lengthy and exhaustive monograph. This portion contains the following sections:—Derivatives of anthrachinon; bibrom-anthrachinon, $C_{14}H_6Br_2O_2$; monobrom-anthrachinon—

$$C_{14}HgBr(O)_2";$$

action of nitric acid on anthracen and its derivatives; mononitro-anthracen, $C_{14}H_9NO_2$; dinitro-anthrachinon and its derivatives; action of nitrous acid upon diamido-anthrachinon. To be continued.

Action of Oxygen upon an Alkaline Solution of Alizarine.—Dr. Auerbach.—Reserved for translation.

Adulteration of Sugar with Dextrin.—Dr. C. Scheibler.—The main results of the author's researches on this subject (the adulteration relates to raw unrefined sugar) may be summarised as follows:—The presence of dextrin in unrefined sugar very considerably increases the degree of optical rotation of the sugar. The dextrin may be detected by the action of alcohol upon the sugar solution, by producing therein a gelatinous precipitate or a perceptible turbidity; further, by the colouration with iodine solution; by the impossibility of perfectly clarifying a solution of such sugar with acetate of lead; by the difference of polarisation before and after inversion; and, lastly, by the absorbing action which animal charcoal exerts upon dextrin.

We are glad to find in this number the projected statutes (bye-laws) of—

A French Association for the Advancement of Sciences.—A number of eminent scientific men, assisted by some who take an interest in the advancement of sciences and the spreading of sound useful knowledge, have, it appears, come to an understanding and terms upon which shall be based this new scientific institution, to which we sincerely wish "Quod bonum felix faustumque sit," and useful to the nation which has undoubtedly largely contributed to the immense store of knowledge which the civilised world now possesses.

Bibliography.—Under this heading we announce "Etude sur les Quinquinas," par Pierre-Paulin Carles; an octavo volume published by Baillière, and full of very valuable and well arranged information on this subject, including the methods of analysis of the barks as well as of the ash they yield on being incinerated.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 2, 1872.

This number contains the following original memoirs and papers:—

Contribution to our Knowledge on Spectrum Analysis.—K. Vierordt.—The contents of this memoir, illustrated by diagrams, are, notwithstanding the very high intrinsic merits, not suited for useful abstraction.

Oxidation of Ketons, a Means of Determining the Constitution of Acids and Alcohols.—A. Popoff.—In the first portion of this paper, the author quotes some particulars taken from a work, edited by him and published in the Russian language, on the general rules relating to the oxidation of the ketons. When ketons are selected in which one of the alcohol radicals combined with carbonyl is phenyl, methyl, or ethyl, then, by the oxidation, the carbonyl remains combined with this alcohol radical, while the other alcohol radical becomes oxidised, and, if that other radical is that of a normal alcohol, the result is the formation of a normal acid; if, on the other hand, it is an an iso-alcohol radical, an iso-acid is formed, while a secondary alcohol radical yields an aceton, and, as for a tertiary, it becomes split up. The greater portion of this essay is devoted to the exhaustive description of a series of experiments made with the view of testing the correctness of the views above given.

Preliminary Communication on Amido-Benzol-Sulpho Acid.—H. Rose.—The nitro-benzol-sulpho acid, obtained by treating nitro-benzol with fuming sulphuric acid, yields an amido-benzol-sulpho acid, which, when in dilute solution, imparts an intense yellow colour to fir-wood, and exhibits (viz., the aqueous solution) a very characteristic reaction with chloride of copper under the following conditions:—The chloride alone does not give any reaction with the aqueous acid fluid; but, when simultaneously some chloride of ammonium and ammonia are added, when the liquid is boiled, a deep red colouration of the fluid ensues; when it is treated with sulphuretted hydrogen for the purpose of eliminating the copper, the colouring substance becomes reduced, and the colouration of the solution thereby converted to a brownish hue; but, by oxidation in contact with air, the red colouration is restored, and, on evaporation of the liquid on the water-bath, there is, along with chloride of ammonium, left the pigment, which is readily soluble in water and alcohol, but insoluble in ether and benzol. This pigment is destroyed by chloride of tin and nitric acid, but is soluble in strong sulphuric acid without any change. The author is engaged with further experiments on this subject, and also on a different nitro-benzol-sulpho acid and amido acid derived therefrom.

Further Researches on Artificial Coniine.—H. Schiff.—This essay opens with the detailed description of the method of preparation of coniine by artificial means, starting with butyraldehyde exposed to direct sunlight for several months along with alcoholic ammonia solution kept in a well-stoppered bottle. The artificially-obtained alkaloid is, as regards its physiological action, akin to the natural coniine obtained from *Conium maculatum* and *Cicuta virosa*. The boiling-point is from 168° to 170°, and also that of the native; the specific gravity varies from 0·893 to 0·899 at 15°. The main difference, as regards the properties of the native and artificially-prepared coniine, is that the latter does not exhibit any optical rotatory action. Constitutional formula—

$$\begin{matrix} CH_3 \\ CH_3 \end{matrix}\!\!>\!CH\!-\!CH\!=\!CH\!-\!N$$

$$=\!CH\!-\!CH_2\!-\!CH\!<\!\begin{matrix} CH_2 \\ CH_2 \end{matrix}$$

Researches on the Uric Acid Group.—M. Nencki.—After first briefly referring to his former researches on this subject, the author states that the formula of the body formed by the action of sulphuric acid on sulpho-pseudo-uric acid is $N_4C_5SO_5H_4$. This new acid has been named uro-sulphinic acid; the potassa salt of this acid yields large-saized well-defined crystals. The acid is monobasic and a very weak one, being decomposed by carbonic acid. The constitutional formula of this body, which is rather stable and resists desulphuration, cannot as yet be made up.

Observations on Dr. Flückiger's Communication on the Occurrence of Pyrocatechin in Kino.—Dr. von Gorup-Besanez.—This paper contains a rectification of an error made by Dr. Flückiger

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(see CHEMICAL NEWS, vol. xxv., p. 57) in reference to the author's paper, quoted in the work just alluded to, the gist of the matter being that the pyrocatechin in kino is derived from the living plant, because in the *Butea* kino, prepared it appears at a rather high temperature the pyrocatechin is absent.

Meaning (Bedeutung) of the Atomicity of the Elements.—A. Michaelis.—An algebraical essay.

Some Derivatives of Benzol.—V. Meyer and O. Stüber.—The first part of this essay treats on the three modifications of dibrom-benzol, *resumèd* in the following manner:—

Dibrom-benzols.	Fusing-point.	Boiling-point.	Behaviour with Nitric Acid.	Mono-nitro Derivative.
Couper's (1,4)	+89°	219°	Dissolves by the aid of heat	Foliated or needle-shaped crystals fusing at 84°
Reise's (probably 1,2)	−1°	From 213° to 215°	Dissolves in the cold with evolution of heat	Small needle-shaped crystals fusing at 58°
Meyer and Stüber's (probably 1,3)	Fluid at −28°	About 215°	Dissolves by the aid of heat	Needle-shaped crystals fusing at from 60° to 61°

The second part of this essay treats on dibrom-aniline, obtained by treating pure dibrom-benzol first with fuming nitric acid, next precipitating with water, washing upon a filter the nitro-product obtained, and reduction of that body by means of tin and hydrochloric acid. The base thus obtained, dibrom-aniline, is a solid beautifully-crystallised body, but difficultly forming salts, all of which are very prone to decomposition, the acids being only loosely fixed to the base.

Butylen-Glycol, a New Product of the Condensation of Aldehyde.—A. Kekulé.—In the lengthy purely-speculative introduction to this paper, the author observes that it would be interesting to obtain a body bearing to acetaldide the same relation as hydrobenzoin to benzaldide, since such a body would be a bivalent alcohol, a butylen-glycol, $C_4H_{10}O_2$. By a series of difficult and rather complex as well as circuitous experiments, the author has obtained such a body, a very limpid thickish fluid, akin to glycol, exhibiting a sweetish slightly acrid taste, boiling at from 203·5° to 204°, readily soluble in water and alcohol, but not so in ether; formula, $C_4H_{10}O_2$. The remainder of this essay treats at great length on the oxidation products of this substance, these researches having been undertaken with the view to ascertain the constitutional formula as well as to verify the nature of this new body, but, since this part requires for its due understanding the reproduction of a large number of complex formulæ, we do not enter into further details on this subject.

American Journal of Pharmacy, February, 1872.

In addition to several valuable papers on pharmacy, this number contains the following original papers and memoirs bearing upon chemistry:—

Pepsin: a New Practical and Reliable Method to Prepare it; its Properties and Digestive Strength.—E. Scheffer.—This lengthy memoir contains a detailed and practically available account of the author's exhaustive experiments on this subject, from which we summarise the following:—Preparation of pepsin: the mucous membrane of a previously well-cleaned hog's stomach is dissected off, chopped finely, and macerated in water acidulated with hydrochloric acid for several days, during which time the mass is frequently well stirred; the resulting fluid is strained, and, if not clear, set aside for twenty-four hours, in order to allow the mucus to settle. To the clarified liquid, a thoroughly saturated solution of chloride of sodium is added, and the whole thoroughly mixed. The pepsin, separated from the rest of the solution by the addition of the saline solution, is found floating on the surface of the fluid, and is removed with a spoon, put upon cotton cloth to drain, and finally submitted to strong pressure, to free it as much as possible from the salt solution. The air-dry pepsin is a very tough substance, and presents according to thickness a different appearance—resembling in thin sheets parchment-paper, and in thick layers sole-leather; its colour varies from a dim straw-yellow to a brownish yellow. Besides a little mucus, it contains a small quantity of phosphate of lime and chloride of sodium. In order to purify the pepsin thus obtained still further, it is again dissolved in acidulated water, filtered through paper, again precipitated with a solution of salt, and again further treated as above mentioned. Recently precipitated pepsin is very soluble in water, but when once air-dry it dissolves but slowly, and only in small quantities, in that liquid. The aqueous solution has a neutral reaction, is coagulated by boiling, and yields with alcohol a transparent gelatinous precipitate. With sulphate of copper it remains at first clear, but after several hours becomes turbid; with bichloride of mercury, a white precipitate is immediately formed. Tannin, as well as nitrate of lead, forms white precipitates. The precipitate formed by adding chloride of sodium to an aqueous, not too concentrated, solution of pepsin, exhibits at first a jelly-like transparent appearance, which disappears upon stirring, the liquid acquiring a slightly opalescent appearance; after a short time it becomes more turbid, and small flakes are noticed floating in it, which will soon form into small transparent globules, and as such rise to the surface. When the quantity of pepsin in a liquid is very small, the opalescence and turbidity are hardly noticed, but after some time the small globules will appear on the surface. The aqueous solution of pepsin is readily decomposed, and, after the fourth day of having been [illegible] emits a disagreeable odour, while small flakes separate from the clear solution. The aqueous solution of pepsin shows very little action on coagulated albumen, but the latter dissolves readily after the addition of a few drops of hydrochloric acid. An acidulated solution of pepsin (1 fluid ounce of water containing 1 grain of pepsin and 2 drops of hydrochloric acid) gave rise to the following reactions:—By boiling, the clear liquid becomes turbid, and, upon cooling, deposits flakes; addition of alcohol, clear at first, but, upon standing, pepsin in the shape of flakes is deposited; strong hydrochloric acid produces slight turbidity, which disappears by the addition of more acid or by dilution with water; chloride of sodium gives the characteristic precipitate; bichloride of mercury produces opalescence; tannin forms a heavy precipitate soluble in HCl; gallic acid, no action; carbonate and bicarbonate of soda produce a precipitate soluble in excess; a solution of carbonate of soda cautiously added to a solution of pepsin produces a precipitate which, upon being separated from the liquid, will prove to be pepsin again, but a little more carbonate of soda will re-dissolve it again, and the liquid no longer contains pepsin, which is then destroyed, as far as is concerned its power of dissolving, after acidulation with HCl, freshly coagulated albumen. The author further treats at length on the digestive power of pepsin; on pepton, that is to say, the albumen dissolved and digested by pepsin; on the digestive power of pepton; action of pepsin on milk; and on the incompatibility of alcohol with pepsin.

New Dye-Stuff.—Dr. J. M. Merrick.—Under this heading the author speaks of flavine, also sold under the name of aurantine, and which, according to reliable information, is a preparation of quercitron bark, well known in Europe, and manufactured in the United States by a process kept secret. According to the researches made by Drs. Bolley, Brunner, and König, flavine is sometimes nearly pure quercitrine, sometimes quercetine, and usually a mixture of the two. By dissolving the dye-material contained in quercitron bark in an alkaline solution, and next treating it with sulphuric acid, Hochstætter and Oehler have obtained a flavine-like substance.

La Revue des Scientifique de la France et de l'Etranger, February 3, 1872.

This number does not contain any original papers relating to chemistry, but we must not neglect to call special attention to the discourse published herein—

On Vital Force.—J. d'Omalius d'Halloy.—A very lucid and well-digested speech delivered by the celebrated Nestor of Belgian science just named.

The Tithionic (Geological) Deposit and the New German School.—E. Hébert.—A lecture on the chalk and limestone deposits.

February 10, 1872.

This number does not contain any original papers relating to chemistry, but we call attention to the conclusion of—

Lectures on Anthropology.—Dr. A. de Quatrefages.—The portion here published is the more attractive and highly interesting as treating on quaternary man and his races; on the persistence of the quaternary man; his *rapport* with the now existing races; his part in the formation of modern peoples; and, lastly, on the Prussian race.

Bulletin de l'Academie Royale des Sciences, des Lettres et de Beaux Arts de Belgique, No 11, 1871.

This number does not contain any original papers relating to chemistry, but we quote the titles of the two following essays:—

Experiment bearing upon the Question of the Vesicular Condition of Aqueous Vapour.—J. Plateau.

Second Paper on the Researches on, and Analysis of, Belgian Minerals.—Dr. L. E. de Koninck.

No. 12, 1871.

This number does not contain any original papers or memoirs relating to chemistry.

Journal für Gasbeleuchtung und Wasserversorgung, No. 1, 1872.

This number does not contain any original papers relating to chemistry, but we call attention to a paper on—

The Hydrostatico-Galvanic Gas-Lighter.—Dr. Klinkerfues.—This paper, elucidated by several large-sized engravings, contains the complete description of an apparatus wherewith a large number of gas-lights, including street-lamps, can be instantaneously and simultaneously kindled.

NOTES AND QUERIES.

Estimation of Nitrous Acid.—Would Mr. G. E. Davis say exactly how to proceed in testing nitro-sulphuric acid? What are the calculations which have to be made in order to get the percentage of N_2O_3? Has Mr. Davis compared his process with the urea process?—DISCIPULUS.

Carbon-Trichlor-Bromide.—In the second number for January of your esteemed journal, I find an extract from the *Gazzetta Chimica Italiana* of Dec., 1871, in which the combination CCl_3Br is calle

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Paterno a *new* combination. I prepared, although in an entirely different manner, the same combination long ago; I called it carbon-trichlor-bromide, and obtained it by the decomposition of the trichlor-methyl-sulfon-bromide, as described in 1869 in the *Zeitschrift für Chemie* (Oct.), and CHEMICAL NEWS, vol. xx., p. 276.—O. LOEW, New York, Feb. 4, 1872.

Yellow Dye-Stuff.—There has recently been brought into the market here a new and excellent yellow dye-stuff called aurantine, and as it has, I believe, been sold and used in England, I should be glad to get some information concerning it through the columns of the CHEMICAL NEWS. As sold here it is a fine yellow powder; organic evidently in its origin, and does about as much work as 2½ times its weight in the best Persian berries, either in dyeing or printing. With a bath of 180° F. it gives flavine yellow on mordanted print cloth; with a heat of 212° a full deep orange. I shall be glad to hear from any English chemist who has tested aurantine.—J. M. MERRICK, Boston, U.S.A.

MEETINGS FOR THE WEEK.

MONDAY, Feb. 26th.—Medical, 8.
—— Royal Geographical, 8.30.
—— London Institution, 4. Prof. Odling, F.R.S., "On Elementary Chemistry."
TUESDAY, 27th.—Royal Institution, 3. Dr. W. Rutherford, F.R.S.E., "On the Circulatory and Nervous Systems."
—— Civil Engineers, 8.
WEDNESDAY, 28th.—Society of Arts, 8.
THURSDAY, 29th.—Royal, 8.30.
—— Philosophical Club, 6.
—— London Institution, 7.30. Musical Lecture.
—— Royal Institution, 3. Prof. Odling, F.R.S., "On the Chemistry of Alkalies and Alkali Manufacture."
FRIDAY, March 1st.—Royal Institution, 9. Mr. C. W. Siemens, on "Measuring Temperatures by Electricity."
—— Geologists' Association, 8.
SATURDAY, 2nd.—Royal Institution, 3. Mr. Moncure Conway, "On Demonology."

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THE CHEMICAL NEWS.

Vol. XXV. No. 640.

ON THE

PRECAUTIONS WHICH SHOULD SURROUND TOXICOLOGICAL INVESTIGATIONS IN MEDICO-LEGAL CASES,

AND ON

EVIDENCE IN LAW COURTS.*

By Dr. ALBERT J. BERNAYS,
Professor of Chemistry at St. Thomas's Hospital.

I am happy to have an opportunity of bringing this subject before the Officers of Health of this great metropolis, as I cannot imagine a body of men more capable of founding a sound judgment upon it and of awakening the public mind to its importance. I little thought that such a commentary as that furnished by the cases of the Rev. Mr. Watson and Miss Edmunds would be offered, as it were, in illustration of the subject of evidence in courts of law. But these are so fresh in the thoughts of us all, that I feel myself relieved from the necessity of doing more than offering suggestions. Speaking, however, as a student of science, and with no authority on the subject of medicine, I shall commence by calling your earnest attention to the precautions which should surround toxicological investigations in medico-legal cases.

In the first place, I should say that in all cases of suspicion, where the symptoms call for enquiry, the post-mortem examination should always be conducted or witnessed by an expert, in addition to the local medical man. These two should settle between themselves, and *before commencing operations*, the *plan* of proceeding. Nothing should be left to haphazard. The portions of the body to be taken for analysis, provision made for the reception of these, symptoms carefully observed and noted; these are among the most obvious preliminary preparations.

But now as to the analysis. Who is to conduct it? Whatever our opinions may be as to the necessity of the work being performed by a medical man or a simple chemist, in this we shall agree, that the analysis should be carried out by a practiced hand.

Very few medical men, unless they devote themselves to the practice of chemistry, can trust themselves to execute an analysis, whatever their theoretical knowledge may be. In addition to this, it will also be granted that so medical men in full practice can find the necessary time for the work without neglecting their own more proper sphere.

It is for this reason I maintain that the analysis should be undertaken by one who is habitually experimenting. This precaution is as necessary with the chemist as with the chemical physician. It is quite as possible that the chemist may fail as the physician, for some chemists are only theoreticians, and quite incapable of executing with their hands the behests of the brain. If the work to be done is physiological rather than chemical, then the preponderance of the workers should be physicians rather than chemists. But one of my strong points is this, or, rather, I ought to say, one of the points I would wish to enforce is this—*The analysis should not be left to any one individual, whatever his talents may be.* The good chemist may be a bad microscopist and nothing of a physiologist. The good physician may be practically ignorant of chemistry, and, anyhow, may not have kept up the

improved methods of analysis. So that we come to this: the work of thought and act should be carried out by three witnesses. Of these three, two should be experienced in analysis, and the jury of experts that I would select would be the local physician, a medical chemist, and a chemist. If there be not two practical men, then the present system might as well continue, for one good practical chemist could command the results, by carrying them out just as he wished.

Supposing, then, it be decided that the truth shall be established by the mouth of two or three witnesses; the work would be undertaken under a sense of responsibility which at present is very much wanting. Before even the vessels are opened, a consultation would have taken place as to what was to be done. And here comes in one of the great advantages of the scheme. The pure physician might say that he required a certain portion of the contents of the stomach, as a test of the wholesomeness or otherwise, to offer to some animal. The chemist might object on the score that such might not be injurious to an animal. Then the animal on which to experiment would be resolved upon; thus, if strychnine were the suspected poison, the frog would be the first thought; nothing would be left to accident, nothing to afterthought; every method of analysis would be settled, and every preparation made before the work was entered upon.

If we should then settle upon these preliminaries, an important question remains. Who are the physicians and chemists to be called in in such enquiries? And here I must be allowed to protest most vigorously against that principle of centralisation which has hitherto so much prevailed. Why should not the country be mapped out in the same way as at present in the case of coroner's districts. If a competent person reside in the district, it would not be unfair to the coroner to consider it his duty to call upon such person to perform the analysis. If this were a settled principle, there would be much more encouragement to men of science to settle down in different parts of the kingdom. Instead of all analytical work being given to two or three men, however able, the opportunities thus afforded would train up other men of experience. It is not consistent with common sense to say that A. is more experienced than B. if you never give B. a chance; all experience centres in A., and much of it dies with him. The similar assertion that B is not so well-known as A is self-evident; a person can never learn to swim if he never goes into water.

Supposing then these matters settled, or capable of arrangement, another matter occurs to me, for which I would venture to offer a solution. In certain cases, a dispute may arise between interested, not only as to whether poison has been given, but it may be the interest of one party to *prove* death by poison, and of the other to prove natural death. Such a case would be of rarer occurrence, and would probably be applicable only to animals. Let me adduce an illustration: An ox has been grazing in a field, it which it might, possibly, come by its death through metallic poison. If the event took place it would be the interest of the farmer to prove that the animal thus died; and equally would it be the interest of the mining agent to elicit the contrary fact. Now in a case like this, is the analysis to be left to one individual, and is judgment to be given according to his results? Let me show the fallacy of such an arrangement. It may be a trumped up case; the poison may have been put in beforehand; although such a thing may be of rare occurrence, it has already happened, and may happen again [case stated].

This would show the necessity for some different arrangement in the method of analysis. The interests of both parties would be provided for, in that the results of the analysis would depend upon the evidence of three witnesses.

Another question arises. Is it advisable to give to the chemists engaged any information as to the nature of the suspected poison and as to the medicines which may

* Read before the Medical Officers of Health, Feb. 17, 1872.

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been given? I cannot help thinking that it would be desirable, as well as a matter of expense as of actually preventing an arrival at incorrect conclusions. In the first place, it would be a saving of expense, as in most cases the labour involved would be lessened. In the second place, it might prevent the finding of the real poison by the discovery of a medicine which in overdose alone would be a poison. Speaking to men of science, I will not enlarge upon these points, as your own experience will immediately fill up the gaps which I intentionally leave for you.

And now comes, perhaps the most important question, How is the evidence to be given?

I confess when I hear that the evidence which I shall give shall be the truth, the whole truth, and nothing but the truth, my heart sometimes fails me. I may give an illustration of personal experience, but there is really no occasion. Any one of us who may have been present in courts of law must have come away with the conviction that you may get plenty of law, but very scant justice. We know that in most cases the strife is for victory, rather than for truth. If we are rich, we can buy the best defence, whether scientific or otherwise. Indeed, we may be so wealthy that we can employ all the chief scientific witnesses, and therefore leave to our adversary no defence beyond what he can elicit through cross-examination. In what conceivable way can we admit that we tell the whole truth when we know that we go into the witness-box simply to tell *our* story? We may have heard from previous witnesses facts of which we had previously no knowledge, such as would have prevented us from giving evidence at all. The truth of our case depends too much upon the ability of our counsel either to suppress or overthrow evidence. I have seen a great case break down the moment the chief advocate left us; and I have seen the weakest case become strong through the able conduct of our adviser. As regards scientific witnesses, the great object of the lawyer is to confound them. If a timid man, the blustering "So you mean to say, sir" is quite enough to drive all the learning out of his head. The less a man knows, the more self assurance he possesses, and consequently the more esteemed is his evidence. "Give me a man as a scientific witness," said a leading police inspector, "who has no doubts." Can it, then, be wondered at that some men refuse to be sworn, and, consequently, to give evidence? I have a friend great in science, but I know that nothing short of a subpœna would ever induce him again to give scientific evidence in a court of law. From his great knowledge he makes a bad witness. He sees the bearings of questions, and naturally fences with them, so as not to compromise himself. But seat him at a table in a quiet room, with pen, ink, and paper, and you would not find a man who could better sift a case.

I cannot help thinking that the better mode of giving evidence, on the part of experts, would be in writing. I would give every possibility for *viva voce* examination on the part of the judge, and would allow counsel to suggest questions. But the conclusions the scientific witnesses have come to should be at once recorded in writing, and, as long as the barbarism is thought necessary, sworn to.

And in matters concerning the public health, of which you are the appointed guardians, do you not think that the proof, or otherwise, of a nuisance would be arrived at with greater certainty and with far less expense by a jury of experts than by the present system? How often does it not occur that more money is wasted upon witnesses than would be required to put chemical works into substantial repair! How frequently is undeserved ruin the penalty for the defence of unscientifically-conducted chemical works!

What, then, according to my imperfect view, is the conclusion of the whole matter?

(1). That greater safeguards should be established in obtaining evidence.

(2). That no chemical analysis involving life and death should be left to the discretion of one individual.

(3). That the selection of experts, whether medical or chemical, or both, should be made from a wider sphere.

(4). That the evidence of such men should be taken in writing and published before the trial, so that no one may be taken by surprise, and to give opportunities for the preparation of an answer.

(5). That the examination of scientific witnesses be entirely left to the discretion of the judges, and that counsel be only allowed to suggest questions to the judges, and not put them themselves.

(6). That in nuisance cases the matter in dispute be referred to seven men, medical and chemical, three to be selected on each side, the seventh to be appointed by both sides, and these seven to be exclusive of the medical officer of health, who has probably reported the case; and that only in case of non-agreement the matter be brought to public trial.

I have intentionally made short work of this paper, so as to give proper opportunity for debate. I believe the subject to be an important one, and the opinions, in part at least, are not new to many. But I am not conscious to have taken them from anyone, for I have held them and broached them many times for many years past. To us the question is alone pertinent, not Is it new? but Is it true? Let us regard it in that light, and deal with the matter, and not with the individual who brings it forward.

ON THE GASES CONTAINED IN COKE,

AND ON THE APPLICATION OF THE

SPRENGEL OR MERCURY AIR-PUMP TO THE ANALYSIS OF COKE.

By JOHN PARRY,
Ebbw Vale Iron Works.

It has always been a doubtful question with most chemists and metallurgists whether coal could be completely deprived by heat of its volatile constituents. The usual rule has been to expose the coal in a closed crucible to the heat of a gas or spirit blowpipe, and to assume the residue (after it had ceased to lose weight) to contain only carbon, and incombustible matter or ash.

Nevertheless, Dr. Percy and others have called attention to the fact that coke from the hardest burnt coals, on being subjected to elementary analysis, showed a loss of carbon. This loss might have been due to errors of analysis, but it was so constant that it has been generally assumed it is due to the presence of gaseous matter, by inference oxygen and nitrogen.

The author has, however, found that, contrary to the general opinion, coal persistently retains hydrogen, and even at the highest at his command (a Sefstrom's furnace) he has failed to entirely free coal from volatile matter; also that all kinds cannot be deprived of their volatile constituents with equal facility by merely heating in a closed crucible.

The writers attention was more particularly directed to this from the fact that he found great difficulty in freeing a sample of coal (sent to him for examination) from volatile matter. The coal was analysed with the following results:—

No. I. Coal.

Elementary Analysis.

Carbon.	Hydrogen.	Sulphur.	Ash.	Oxygen and Nitrogen.
65·600	4·243	0·807	5·170	24·180

Proximate Analysis.

Gas Coke.	Tar.	Water.	Illuminating Gas.
82·69	4·67	3·00	9·64

On heating 100 of this coal in a closed crucible at a heat which, from experience extending over many years,

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had always been found sufficient and to agree closely with results on the large scale* at the works, it gave 77·28 of coke; this not agreeing with the elementary analysis, several combustions were made, with results agreeing closely. It was therefore inferred the coke still contained volatile matter.

800 grs. of the gas coke was now heated to full redness in a small iron retort. Gas burning with a pale blue flame was rapidly given off for the first hour, then very slowly, and ceased in 30 minutes; total time, 1½ hours. Coke in retort weighed 759 grs. = 5·2 per cent loss.

100 grs. coke from retort heated in closed platinum crucible (Griffin's gas furnace and large burner used) lost:—1·15 hours, 1·9; 3½ hours, 9·8; 1·40 hours, 12·9. Total loss, heated 6·25 hours = 12·9 per cent.

20 grs. of the coal over large burner as above heated 4½ hours weighed 14·3; again 1·35 hours, 13·6; again 1·40, 12·8 = coke, 64·00; loss, 36·00.

Analysis of Gas Coke.

Carbon.	Hydrogen.	Sulphur.	Ash.	Oxygen and Nitrogen.
84·360	0·187	0·850	8·300	6·303

Analysis of Coke Heated 7·55 hours.

Carbon.	Hydrogen.	Sulphur.	Ash.	O and N by diff.
89·450	trace	0·795	8·450	1·305

In order to further test the gas coke, 20 grms. were heated in a Sefstrom's furnace for 3 hours; lost 3·6 grms. = 18·6 per cent loss.

20 grms. of the above heated coke heated *in vacuo* under the Sprengel pump for 2½ hours gave 7·664 centims. of gas, containing, per cent—

Carbonic Acid.	Carbonic Oxide.	Hydrogen.	Nitrogen by diff.
75·77	5·60	18·13	0·50

Volume of coke (measured), 15·4 c.c.

It now occurred to the author that it would be interesting to subject the gas coke to heat under the Sprengel pump, collecting and testing the evolved gases from time to time. 20 grms. used and heated 2½ hours gave 301·5 c.c. gas containing—

Carbonic Acid.	Oxygen.	Carbonic Oxide.	Hydrogen.	Marsh Gas.	Nitrogen.
22·80	0·00	13·49	50·00	13·80	0·00

Also water and tarry matter.

Again heated 7 hours, 586 c.c. gas, containing—

CO_2.	CO.	Hydrogen.	Marsh Gas.	N.
3·10	3·30	93·45	0·00	0·00

Again heated 1½ hours, 63·6 c.c. gas, containing—

CO_2.	CO.	H.
5·721	5·150	89·129 by diff.

Again heated 1½ hours, 80·00 c.c. gas, containing—

CO_2.	CO.	H.
4·800	5·110	90·090 by diff.

Again heated 1 hour, 62·5 c.c. gas, containing—

CO_2.	CO.	H.
9·65	0·70	89·65

Again heated 1 hour, 21·6 c.c. gas, containing—

CO_2.	Oxygen.	CO.	H.	N.
9·385	0·00	8·200	81·200	1·215

Total, 1117·2 c.c. gas from coke heated 14½ hours in glass tube in gas flame = about 72·5 volumes of coke used.

All the gas was not extracted, but in attempting to cool down the tube for next class experiments it cracked, and consequently spoilt the experiment. Taking, however, the previous trial of the coke heated in Sefstrom's furnace, it is pretty evident hydrogen is eliminated, leaving principally only carbonic acid.

A sample of a different vein of coal was now taken and examined.

* Another chemist of considerable experience also gave 77 coke, same to the writer and before he had commenced these experi-

No. II. COAL.

Elementary Analysis.

Carbon.	Hydrogen.	Sulphur.	Ash.	O and N by diff.	Coke.
73 688	4·956	1·826	7·300	12·23	63·50 p.c.

20 grms. of the coke under Sprengel pump—

		Gas.	Carbonic Acid.	Oxygen.	Carbonic Oxide.	Cyanogen.	Hydrogen.	Nitrogen.
		c.c.						
No. I.	Heated 2 hours	28	77·12	trace	4·153	0·00	0·000	17·780
	Again 2½ „	32	33·22	0·00	0·000	0·00	34·561	31·000
	4½ „	60						

20 grms. of coal again coked 4 hrs. 20 mins. in Sefstrom's furnace gave only 62·2 per cent coke (under Sprengel pump)—

		Gas.	Carbonic Acid.	Oxygen.	Carbonic Oxide.	Cyanogen.	Hydrogen.	Nitrogen.
		c.c.						
No. II.	Heated 1 hour	32·5	67·419	0·00	12·420	0·00	5·325	14·900
	Again 3 „	26·6	61·449	0·00	10·427	0·00	24·564	3·484
	4 „	59·1						

Vol. of coke, 20 grms. = 16 c.c. = about 3·75 vols. of gas to 1 vol. of coke. Coke made from the above coal at the works, thoroughly coked sample taken, dried at a dull red heat, lost 0·933 per cent.

Dried coke under Sprengel pump 2 hours gave 51·5 c.c. gas containing—

Carbonic Acid.	Carbonic Oxide.	H and N.
91·400	3·583	5·017

Nos. 1 and 2 analyses differ, but the experiments were carefully made.

The coke from this coal differs from No. 1 in containing nitrogen, which appears to have been eliminated from No. 1 in previous coking. It is in good repute for iron smelting; No. 1 is never used, having been found unfit for use in the blast furnace.

Other samples of coke were now taken from the works and tested under the Sprengel pump, with the following results:—

Hard, well burnt coke; 20 grms., 2 hours under Sprengel pump, gave 79·2 c.c. gas, containing, per cent—

Carbonic Acid.	Carbonic Oxide.	Hydrogen.	Nitrogen.
85·720	8·590	5·680	0·000

Hard coke, mixed coals; 20 grms., 2 hours under Sprengel pump, gave 42·4 c.c. gas, containing, per cent—

Carbonic Acid.	Carbonic Oxide.	H and N. (Both present; H shown by explosion, but not separated)
57·413	28·562	14·025

Analysis of Coke.

Ash.	Sulphur.	Loss at Red Heat.	Loss under Sprengel pump.	Carbon by diff.
12·100	1·400	1·500	0·586	84·414

Common coke exposed in open air for some time, badly coked sample; 20 grms., 2 hours under Sprengel pump, gave 91·7 c.c. gas, containing—

Carbonic Acid.	Carbonic Oxide.	Hydrogen.	Marsh Gas.	Nitrogen.
39·020	7·673	53·317	trace	0·000

Analysis of Coke.

Ash.	Sulphur.	Loss at Red Heat.	Loss under Sprengel Pump.	Carbon by diff.
14·000	1·370	4·820	1·000	78·810

The author thinks it premature to hazard any suggestions as to the effect of the gases shown to be contained in coke when used in the blast-furnace. It is, however, probable that they are only eliminated at a very high heat, and most probably the carbonic acid is retained up to the fusing-point of cast-iron. He has, however, invariably found that what is termed weak coke, *i.e.*, a coke of which a greater quantity than usual is required to smelt a given quantity of ore, always contains the largest proportion of

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hydrogen, and that nitrogen is absent, or present only in very small quantity.

The author is now engaged in testing for occluded gas the ores and flux used in the blast furnace, with a view of quantitatively determining the volumes of gas as compared to the volumes of material used, first subjecting the samples to a full red heat until they have ceased to lose weight.

It is well known that both ores and flux are never entirely freed from volatile matter by ordinary calcination; but the amount of gaseous matter contained has *not*, as far as the writer is aware, been determined, and it is hoped that some benefit will be derived by the series of experiments now in progress.

It has been found in most instances that gas is given off by treatment under the Sprengel pump both from the flux and ores; and that argillaceous carbonates of iron contain carbonic acid, even after heating to semi-fusion. That samples roasted until they cease to lose weight, when tested under the Sprengel pump, evolve about three times their own bulk of carbonic acid; and that white cast-iron contains twice its own bulk of occluded gas, of which from 80 to 90 per cent is hydrogen.

NOTE ON THE DOCIMASTIC ASSAYING OF BISMUTH ORES,

AND ON THE

DOCIMASTIC SEPARATION OF BISMUTH FROM COPPER, FROM ARSENIC, FROM ANTIMONY, AND FROM LEAD.

By HUGO TAMM.

(Concluded from p. 87.)

Docimastic Separation of Bismuth from Arsenic.

THE separation of bismuth from arsenic is founded on the almost absolute want of affinity of bismuth for iron, on the readiness with which arsenic combines with iron, and on the fact that the arseniuret of iron thus formed does not alloy with bismuth. This operation, which is extremely elegant, is conducted in the following manner:—

Bismuth is melted at a relatively high temperature, at a bright red heat, under cover of borax or flux, to avoid loss of bismuth by volatilisation, and strips of iron are plunged in the molten metal. Iron is, according to the technical expression, rapidly "eaten away," forming arseniuret of iron, which rises on the surface of the metal.

When it is ascertained that fresh pieces of iron are no longer attacked, the whole is allowed to cool. The arseniuret of iron sets rapidly, and the bismuth, which is still fluid, is poured out of the crucible into moulds. Singularly enough, this process which succeeds in perfection for the separation of arsenic, is valueless when applied to the separation of bismuth from antimony; although, be it noticed, the affinity of this metal for iron is very great. Some antimony is removed by this process, but part of it only, and, it must be admitted, that bismuth has as much, or more, affinity for antimony than iron.

An analogous instance of these very remarkable *fire affinities* is evinced by alloys of lead and antimony, from which iron fails to remove antimony.

Although iron has no affinity for lead, the respective affinities of those two metals for antimony are so nearly equal that a perfect triple alloy of lead, antimony, and iron, is obtained.

Docimastic Separation of Bismuth from Antimony.

This problem, which was far from being as simple as it looked, was solved, like the other problems contained in these pages, by Newton's universal process of "thinking tantly about it."

best way of separating the two metals is to melt lloy with a quantity of oxide of bismuth, equal to two and a half or three times the weight of the antimony contained in the alloy. The oxide of bismuth is instantaneously reduced to the metallic state, and antimony is liberated under the form of oxide of antimony, which combines with a little oxide of bismuth, and floats on the surface of the pure metal, whence it can easily be removed.

This operation, which is of the simplest description, and is also very elegant, must be performed in clay crucibles, and both carbon and iron must be carefully excluded to avoid any reduction of oxide of antimony. The least traces of antimony may be removed by this process without any difficulty whatever. It may be as well to state here, that an analogous operation answers admirably well for the purification of lead containing antimony. Litharge acts on alloys of lead and antimony, exactly as oxide of bismuth on alloys of bismuth and antimony; the last traces of antimony may be removed by litharge.

Docimastic Separation of Bismuth from Copper.

As I have stated before, when bismuth ores contain only a small percentage of copper, and when the ores are oxidated ores, it is advantageous to reduce them at once by carbon and fluxes, without going through the sulphurising process: and, as a matter of course, all the copper is alloyed with the bismuth.

On the other hand, bismuth extracted from copper ores by the sulphur process contains, even in the best conducted operation, a certain proportion of copper which must be removed. This elimination presented very great difficulties, and could not be effected without losing a large amount of bismuth, until I devised the following method, which is perfect in every respect. Chemically, this method is a modification of the sulphurising process already described; but, practically, it has the advantage of effecting, as thoroughly as possible, a separation which was only approximately obtained by the sulphur process. It is by melting the alloy with sulphocyanide of potassium that I have succeeded in solving this difficult question.

The sulphocyanide which I use is prepared during the process of refining, by mixing together eight parts of cyanide of potassium and three parts of flowers of sulphur. One part of this mixture is thrown over sixteen parts of the metal melted at a low temperature.

A reaction soon takes place, by which the mass of the metal is brought to a bright red heat, and, at the same time, the sulphocyanide begins to burn vividly, throwing, in every direction, showers of scintillating sparks emitting a blue light.

The crucible is covered over, and great care must be taken to prevent the heat from rising above the burning point of the sulphocyanide, a temperature at which sulphuret of bismuth begins to volatilise.

The reaction is allowed to exhaust itself, and, when all is quiet, and after the metal has been well stirred with a clay stirrer (iron must be avoided), the flux is allowed to set, and the metal, which is still fluid, is poured out into moulds.

It is, I believe, the first time that sulphocyanides have been employed, or at least employed with so much success, as docimastic reagents. If those compounds which, as I have pointed out, may be formed by the direct action of sulphur on cyanide of potassium, were more abundant and cheaper, an important revolution, fertile in new applications, might be effected in that most conservative branch of industry—metallurgy.

Manufacturers of cyanides ought really to direct all their attention towards obtaining these compounds by some simple process, and endeavour to supply them at low prices; they would then constitute the most important docimastic and metallurgical reagents imaginable.

The great aim of modern metallurgy ought to be, the production of pure metals. With pure metals numberless alloys difficult or impossible to prepare, or useless, could be manufactured with facility and used

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with advantage; and the difficulties met with in the preparation of alloys with metals of unknown composition would be removed, and with them the secrets and obscure receipts used up to the present day in most manufactories.

It is impossible to lay too much stress on the important question of the preparation of pure metals, but, at the same time, it must be owned that, in many instances, this object cannot be accomplished without the introduction of new reagents and new reactions.

Separation of Bismuth from Sulphur.

The metal obtained in the above operation contains some sulphur. To remove this substance, the metal is melted with iron or carbon; the separation is thus effected as easily as possible.

Docimastic Separation of Bismuth from Lead.

It is with the deepest regret that I have to confess the utter failure of every means, whether simple or complicated, which I have brought to bear on this the most difficult problem of the metallurgy of bismuth.

Lead, it is true, may be removed partially, or even in totality, from its alloy with bismuth, but this removal of lead can only be effected, so to speak, by mechanical means, and it is consequently attended with an enormous loss of bismuth. The true cause of the failure of chemical means lies in the fact that the respective affinities of lead and bismuth are reversed by fire, and that bismuth substitutes itself to lead in the compounds of this metal and precipitates it from them.

I do not pretend to say that this problem is insoluble, but I simply wish to state that, up to the present day, it has not been solved, and that its solution is worth the exertions of docimasts.

Remarks.

The several processes which I have proposed are chiefly useful for the refining of bismuth alloyed with one metal.

There is no docimastic method of refining by one process bismuth alloyed with several metals; but the successive use of the different methods which I have described can safely be recommended.

Copper should be removed first, for the reason that some lead, antimony, and arsenic are eliminated at the same time.

Bismuth should next be freed from antimony, and, lastly, from arsenic and sulphur.

I have described as briefly as possible new processes founded on new reactions, in the hope that they will bear directly on the docimastic assaying and on the metallurgy of bismuth.

The whole looks very simple on paper, but, like simple things, it represents a vast amount of labour. The results obtained do not, perhaps, bear directly on science itself, and belong rather more to technology, but they rest on solid ground. They are independent of the revolutions which the human mind delights in effecting in its own theories, and, I might say, in the words of one of the most eminent analysts of this century, of Balzac, that they are derived from "Ceste bonne philosophie à laquelle besoing sera de tousjours revenir;" meaning, undoubtedly, the direct study of nature.

ON THE

BOILING-POINTS OF THE NORMAL PARAFFINS AND SOME OF THEIR DERIVATIVES.*

By C. SCHORLEMMER, F.R.S.

It is generally asserted that the boiling-points of the members of homologous series increase regularly for each increase of CH_2. Thus it is stated that in the series of the alcohols and fatty acids the boiling-point is raised 19° for each addition of CH_2, whilst in other series this difference is sometimes smaller, sometimes larger, but always the same in the same series. But in many cases the boiling-points calculated by this rule do not agree at all with those which have been observed. One reason for this discrepancy is that the compounds of which the boiling-points have been compared are not true homologous bodies, *i.e.*, that they have not an analogous constitution, although they differ in the composition by CH_2 or a multiple thereof. During the last year, however, we have become acquainted with some true homologous series, *viz.*, the series of the normal paraffins, and the normal alcohols and their derivatives.

In a paper read before the Royal Society I have already pointed out that the difference between the boiling-points of the lower members of these paraffins is not the same, but that it decreases regularly by 4° until it becomes the well known difference of 19°, as the following table will show:—

	Boiling-points. Found (mean).	Calculated.	Difference.
CH_4	—	—	
C_2H_6	—	—	
C_3H_8	—	—	
C_4H_{10}	1°	1°	
C_5H_{12}	38	38	37°
C_6H_{14}	70	71	33
C_7H_{16}	99	100	29
C_8H_{18}	124	125	25
$C_{12}H_{26}$	202	201	4×19
$C_{16}H_{34}$	278	278	4×19

It appeared to me of interest to compare the boiling-points of other normal compounds, selecting of course those only of which the boiling-points have been carefully determined and corrected for pressure and expansion of the mercurial column of the thermometer above the vapour. The result of this investigation is that in most of the other series the difference between the boiling-points also steadily decreases by about 2°; but I am not in a position to state whether this decrease ceases when the difference becomes 19°, as we do not yet know a sufficient number of compounds.

I. *Normal Iodides.*

	Boiling-points. Observed.	Calculated.	Difference.
Methyl, CH_3I	40·0°	40°	
Ethyl, C_2H_5I	72·0	72	32°
Propyl, C_3H_7I	102·0	102	30
Butyl, C_4H_9I	129·6	130	28
Pentyl, $C_5H_{11}I$	155·4	156	26
Hexyl, $C_6H_{13}I$	179·5	180	24
Heptyl, $C_7H_{15}I$	—	202	22
Octyl, $C_8H_{17}I$	221·0	222	20

Normal Bromides.

	Observed.	Calculated.	Difference.
Ethyl, C_2H_5Br	39·0°	39°	
Propyl, C_3H_7Br	71·0	71	32°
Butyl, C_4H_9Br	100·4	101	30
Pentyl, $C_5H_{11}Br$	128·7	129	28
Hexyl, $C_6H_{13}Br$	—	155	26
Heptyl, $C_7H_{15}Br$	—	179	24
Octyl, $C_8H_{17}Br$	199·0	201	22

Normal Chlorides.

	Observed.	Calculated.	Difference.
Ethyl, C_2H_5Cl	12·5°	13°	
Propyl, C_3H_7Cl	46·4	46	33°
Butyl, C_4H_9Cl	77·6	77	31
Pentyl, $C_5H_{11}Cl$	105·6	106	29
Hexyl, $C_6H_{13}Cl$	—	133	27
Heptyl, $C_7H_{15}Cl$	—	158	25
Octyl, $C_8H_{17}Cl$	180·0	181	23

* Read before the Manchester Literary and Philosophical Society, [illegible]

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Normal Acetates.

		Observed.	Calculated.	Difference.
Ethyl,	$C_4H_8O_2$	74·0°	74°	
Propyl,	$C_5H_{10}O_2$	102·0	101	27°
Butyl,	$C_6H_{12}O_2$	125·1	126	25
Pentyl,	$C_7H_{14}O_2$	148·4	149	23
Hexyl,	$C_8H_{16}O_2$	168·7	170	21
Heptyl,	$C_9H_{18}O_2$	—	189	19
Octyl,	$C_{10}H_{20}O_2$ ..	207·0	208	19

Whilst in these series the difference between the boiling-points steadily diminishes, in the series of the normal alcohols the difference appears to remain the same, being about 19°.

Normal Alcohols.

		Observed.	Calculated.
Ethyl,	C_2H_6O	78·4°	78·4°
Propyl,	C_3H_8O	97·0	97·0
Butyl,	$C_4H_{10}O$	116·0	116·0
Pentyl,	$C_5H_{12}O$	137·0	135·0
Hexyl,	$C_6H_{14}O$	156·6	154·0
Heptyl,	$C_7H_{16}O$	—	173·0
Octyl,	$C_8H_{18}O$	192·0	192·0

In the series of the normal fatty acids the difference between the boiling-points of the lower members is also constant, being 22°, but afterwards it becomes less.

Normal Fatty Acids.

		Observed.	Calculated.	Difference.
Acetic,	$C_2H_4O_2$ ..	118·0°	118°	
Propionic,	$C_3H_6O_2$ ..	140·6	140	22°
Butyric,	$C_4H_8O_2$ ..	163·2	162	22
Pentylic,	$C_5H_{10}O_2$ ..	184·5	184	22
Hexylic,	$C_6H_{12}O_2$ ..	204·5	206	22
Heptylic,	$C_7H_{14}O_2$ ..	220·0		
Octylic,	$C_8H_{16}O_2$ ..	233·0		
Nonylic,	$C_9H_{18}O_2$ ..	254·0		

ON THE ACTION OF LOW TEMPERATURES ON SUPERSATURATED SOLUTIONS OF GLAUBER'S SALT.*

By CHARLES TOMLINSON, F.R.S.

When a solution of the ordinary ten-atom hydrate of sodic sulphate, saturated at about 93° F., its maximum point of solubility, is boiled and filtered into a clean flask, which, being closed, is left to cool to 40° and under, a modified or seven-atom hydrate is formed at the bottom of the solution; this increases in quantity as the temperature falls, and passes into solution as the temperature rises; and so far the observation is supposed to be complete.

But if a supersaturated solution of Glauber's salt be reduced from ordinary atmospheric temperatures to low ones by means of a freezing mixture of snow and salt, the results obtained are very remarkable.

A solution of 1 part of Glauber's salt in one of water was boiled and filtered into a two-ounce flask that had been previously filled with strong nitric acid and well rinsed with clean water. The solution was again boiled in this flask, into which a thermometer was passed, the stem being surrounded by several turns of lamp-cotton, which served to close the flask as soon as it was removed from the source of heat.

Next day the flask was put into a freezing mixture at about 15° F. The solution slowly sank to 19°, when there was an abundant deposit of crystals of a peculiar opaque white, not like the transparent octahedra that are thrown down when these solutions cool to 40° and under, but very much like the octahedral crystals formed during the cooling of a strong solution of sal-ammoniac. There were tufts of regular octahedra and fern-like crystalline forms. During their formation the thermometer rose to 26°. The flask was now transferred to water at 48°, when the opaque white crystals broke up into an amorphous woolly mass. As the temperature of the solution rose to 40°, then for the first time the usual transparent octahedra of the anhydrous salts fell down. Next day the flask was opened; crystallisation of the ordinary salt set in from the surface, and the temperature rose from 44° to 65°.

Thus one more hydrate is added to those already known as belonging to this remarkable salt. It doubtless contains less water than the seven-atom hydrate; but I know of no method of testing its hydration, since its existence depends upon the low temperature and shelter from the action of nuclei. In this way it resembles the various hydrates described in my paper in the *Transactions*.

The solution was next made twice as strong as before; that is, 2 parts of Glauber's salt were dissolved in 1 part of water, and after boiling and filtering and re-boiling as before, the flask was set aside to cool. When the thermometer marked 42°, the flask was put into the freezing mixture. At 38° a few transparent octahedra were thrown down, and the heat currents thereby liberated delayed the cooling. In fourteen minutes it reached 26°, and the transparent crystals at the bottom became opaque white. The thermometer was stationary during some minutes at 26°, when it began again to descend; but on agitating the flask in the freezing mixture, crystals of the opaque white salt were formed, and the temperature regained 26°, the solution above being bright and clear and still supersaturated. In a few minutes crystallisation set in from the surface, and the thermometer rose from 26° to 53°, the whole being now solid.

These opaque crystals resemble in texture newly formed white-lead, and at whatever temperature they may be formed below 26° their formation causes the thermometer to rise to 26°, and that, too, in solutions of 1 part, 2 parts, or 3 parts of salt to 1 of water. This opaque salt is sometimes amorphous, and then it covers the surface of the flask like thick whitewash. This effect occurs when the flask is much agitated in the freezing mixture.

The same flask (2 of salt to 1 of water) was re-boiled without any addition of water, so that the solution was really stronger than that indicated. At 40° there was a fall of transparent anhydrous crystals. The solution was now purposely cooled very slowly, so that in half an hour it descended only 3°, *viz.*, to 37°. There was now a considerable increase of the anhydrous salt, so as to cover the bottom of the flask and to rise a little way up the sides. The flask was tranferred to a freezing mixture at 10°; when at 33° the anhydrous salt became opaque, doubtless from the fixation of a portion of water less than that required for the formation of the seven-atom salt. At 24° opaque tufts and fern-like crystals were formed. At 22° there was a sudden and copious deposit of this opaque white hydrate; thermometer rose to 26°, and then suddenly to 52°, when the whole mass was solid.

It is commonly supposed that the rise in temperature consequent on the solidification of a supersaturated solution is dependent on its mass; that when this is considerable the rise in temperature is so too, but that when the mass is small there is but little heating. This does not accord with my experience. Not much more than half an ounce of a comparatively weak solution of Glauber's salt, such as 1 of salt to 1 of water, may rise from 20° to 56° on suddenly becoming solid, and with 2 or 3 of salt to 1 of water the rise may not be greater, especially if a considerable mass of the two abnormal hydrates be already formed, and only a small portion of the solution remain to become solid.

In another experiment, 3 parts of salt to 1 of water

* *Abstract of a Paper read before the Royal Society.*

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were boiled and filtered into two test-tubes and one two-ounce flask. One tube, on being put into the freezing-mixture, sank to 35°, when the solution suddenly became solid and the thermometer rose to 78°. The other tube solution threw down so large a quantity of anhydrous crystals as to prevent the reading of the thermometer. The solution in the flask threw down anhydrous crystals at 44°, and then sank very slowly to 40°, where it remained stationary upwards of ten minutes, in consequence of the liberation of heat-currents, occasionally rising to 41°. A large quantity of transparent crystals was now heaped up on the bulb of the thermometer; the temperature descended to 38°, with slight starts upwards; and in slow descending to 33° there was a large increase of the transparent crystals. At 32° the flask was transferred to a fresh freezing mixture at 10°, and the solution slowly descended to 22°, when it was again removed to a fresh freezing mixture, also at 10°. Soon a number of large fern-like crystals covered the side of the flask, starting apparently from the top of the copious deposit first produced, and rendering the upper part opaque in a well-defined line. The temperature rose to 26°, and continued there some minutes, when the solution suddenly crystallised and the thermometer rose to 48°.

Supersaturated solutions of potash alum, exposed to low temperatures, behave much in the same way as the solutions of double salts described in my former paper. 300 grs. of the salt in 1½ ozs. of water, boiled and filtered into clean test-tubes, and, when cold, put into a freezing mixture at about 0° F., displays the beautiful ivy-leaf kind of foliage, of a brilliant white colour, already referred to. The growth starts from the bottom, or from the surface of the solution, or from both, and soon the whole solution becomes solid. If the tube be put into water at 32°, the solid rapidly melts, and the liquid is a clean bright supersaturated solution as before.

Löwel, in his first memoir (*Ann. de Chim. et de Phys.*, 3 série, tome xxix.), found that when supersaturated solutions of Glauber's salt, in sealed tubes, were subjected to temperatures varying from 3° or to 4° C., they often froze and burst the tubes. In one case, where the tube did not burst, the solution, in thawing, caused the state of supersaturation to cease. In another case, the frozen solution thawed, and the liquor became supersaturated as before. Löwel could not reproduce this last effect, nor explain why the thawing should lead to the formation of the ten-atom salt. But as he did not know the conditions of clean and unclean, he was constantly looking out for some catalytic action of the sides of his vessels to explain the many anomalous cases that occurred to him consequent on the use of vessels not chemically clean.

Among the numerous writers on the subject of supersaturation, I know of none that have noticed the formation of the second modified hydrate of sodic sulphate except M. Viollette, who, in a "Mémoire sur la Sursaturation" contained in the *Annales Scientifiques de l'Ecole Normale Supérieure* (Tome Troiséiem-Année, 1866), refers, p. 223, to the formation of another hydrate, "qui cristallise difficilement en forme de choux-fleurs."

NOTES OF

DEMONSTRATIONS ON PHYSIOLOGICAL CHEMISTRY AT ST. GEORGE'S HOSPITAL.

By S. W. MOORE.

XII.

HEALTHY human urine is an amber-coloured fluid, containing in solution various definite chemical bodies and also matter of an indefinite character known as extractives; it has a sp. gr. of from 1·005 to 1·025, a disagreeable bitter taste, a well-marked acid reaction, and a peculiar sweet odour said to resemble violets (?).

The variation in the sp. gr. is due to the fluid being so complicated and so readily influenced by the amount of fluid ingested; in disease this may be even more marked than above, as in hysteria being hardly above the standard, and in diabetes far exceeding the highest normal gravity; when, however, the sp. gr. is as high as 1·030, it should always give rise to a suspicion of wrong.

A very accurate and durable urineometer, invented by Mr. Blaise, may be used for its determination with almost as much precision as the sp. gr. bottle.

The chief constituents of urine are urea, uric and hippuric acids, kryptophanic acid (?), ammoniacal salts, phosphates, &c. Urea, CH_4N_2O, is the chief constituent of urine, and, as far as we at present know, carries off the greater part of the waste nitrogen from the tissues; its proportion is relative to the amount of nitrogenous food ingested; possibly exercise may influence it.

A ready method of noting whether it be in excess in the urine is to add a few drops of HNO_3 to a similar quantity of urine on a slip of glass, and watching the effect under the microscope; if in excess, crystals separate out. By evaporating urine to one-fourth its bulk, and adding HNO_3, a solid mass of nitrate of urea may be obtained.

The method now used for estimating the quantity of urea was invented by Liebig. Nitrate of mercury is made to precipitate the urea, the amount of mercury salt used giving the amount of urea present. It may be as well to mention here that Dr. Thudichum, in his research on urine, discovered a body which he named kryptophanic acid; to this, he says, is due the acidity of the urine. One of its properties is to combine with nitrate of mercury, and form a substance similar to the urea salt; admitting this, it follows that all urea estimations hitherto made have been fallacious. That Dr. Thudichum has seen some reasons for altering his opinion of the constitution of this body is true, but there can be no doubt that a hitherto undetermined body does exist in normal urine.

The normal percentage of urea in urine is from 1½ to 3 per cent.

Uric acid is present in small quantities in healthy urine, but in considerable proportion in that of gouty patients. It forms nearly the whole of the excrement of reptiles, and the greater part of birds.

It forms stones of considerable size in the bladders of persons suffering from this disease, and is frequently an hereditary taint; it is often seen in the urine of children as the "cayenne pepper grains."

Urine evaporated to one-fourth its bulk and treated with HCl yields this acid; it may be recognised by the murexide test.

In the above experiment, hippuric acid may also be thrown down, and may be known by its odour of benzoic acid when burnt.

Benzoic acid, administered internally, is converted into hippuric acid, whilst hippuric acid in the horses' urine is converted into benzoic acid if the animal is not at rest.

The colouring matter of the urine is a complex body, and probably directly derived from the hæmatin of the blood; the urine is always deeper in tint during febrile disturbance. Thudichum obtains several derivatives from it, as omicholine, uropittine, and uromelanine.

The subject has been one of interest to chemists for years, but very little useful matter has been brought forward, and it yet remains for a principle and its ready application to be discovered.

The salts in the urine are obtained by incineration, and are estimated in the usual way.

The kidneys appear to be the main drains to the circulatory system, for most matters of a soluble nature find their way into the urine; thus iodide of potassium is thrown off in less than twenty minutes after being taken, and if the hands be rubbed with iodine paint, in a few minutes iodine may be detected in the urine.

This is true, also, of many other things. Turpentine,

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rubbed on the skin, causes the urine to assume a very pleasant odour; and santonine, taken internally, so affects it as to cause it to stain all linen it may come in contact with.

ON THE MANUFACTURE AND REFINING OF SUGAR.*

By C. HAUGHTON GILL.

(Continued from p. 80).

Lecture IV.

I now come to thelast branch of my subject. Having treated of the preparation of the raw material from its two main sources, viz., the sugar-cane and the sugar-beet, I have now to describe, but in outline only, one of the processes employed in the refining of that sugar, so as to render it fit for consumption. Many of these samples of raw sugar that I have laid before you are really quite uneatable; indeed, I was told this evening that one sample I had left here had been used for making a pudding, which had to be thrown away. It was a specimen of low, raw West Indian sugar, containing some 2 or 3 per cent of sand, and naturally, therefore, the pudding made with it was somewhat gritty.

The sugar refiner has to deal with this raw sugar, and his business is simply to cleanse it—in fact, the sugar refiner has to take dirty sugar and make it clean. And I propose this evening to tell you one process by which he does it, for there are variations in the methods employed, and perhaps no two sugar refiners work in precisely the same manner. I can only, therefore, tell you an outline of what takes place in one set of refineries, and I propose to choose those which turn out their main product in the form of loaves, such as I have placed on the table.

In the first place, I must tell you that the sugar which the refiner has to deal with is, of course, of two sorts, cane sugar and beet sugar, as the case may be, but it makes no difference to him which he employs. Refined sugar, from whatever source it is made, has identically the same properties, and, in fact, cannot be distinguished by any means I am acquainted with. Before entering on the details of the work performed in a refinery, I must mention again what I have previously implied with regard to the nature of raw sugar. In both cases, if you recollect, the more or less purified juice of the cane or the beet respectively has been evaporated with greater or less precaution, to avoid the destructive action of heat and acids, until the solution became a hot saturated solution, and that then the sugar has been caused to crystallise in one way or another. In any case, the sugar crystallised in the concentrated solution somewhat quickly, and, as you saw by the samples I produced, the crystals were small and confused. Now consider the conditions under which they have been formed. They have grown in a solution which contained not only sugar and water, but also a good many impurities, including saline combinations and albuminous bodies, and, at any rate, in the case of cane sugar, very often a considerable amount of actual solid impurities, feculencies of one fluid or another, the *débris* of plant-cells which had remained in the liquid, never having been separated from it, and which, therefore, remain ultimately hanging to the small crystals of sugar formed in the syrup, which consists of sugar, water, and various gummy and other bodies, of which the nature is practically not known.

The syrup surrounding these crystals is of a very sticky nature, and when the mass, consisting of grain sugar and syrup, is allowed to drain slowly by itself, or when it is put into a centrifugal machine, such as I showed you last week, still the syrup is not perfectly separated from the grains of sugar. Each individual grain of sugar remains wet with the syrup, which syrup is obviously not a pure solution of sugar, and, therefore, the material which is won in this way is not pure sugar. Even if the crystals themselves were quite pure, their remaining wetted with a solution which is not that of pure sugar causes the material itself to be contaminated with various foreign bodies, which it is the refiner's duty to remove.

Now, the impurities adhering to the crystals of sugar are of two kinds—solid ones, which, if washed and dried, would be described in ordinary language as mere fluffiness; and also soluble bodies, which were not removed in the processes to which the juice was subjected. The refiner gets the sugar containing these impurities, and his first operation is to dissolve that sugar in water. This generally performed in large circular cast-iron pans, containing 4 or 5 tons of sugar, with a proportion of water sufficient to dissolve it, which is about half the weight of the sugar. I have so dissolved a quantity of raw sugar here, and it is by no means a bad specimen; still you see the solution is quite cloudy, indicating that there are solid bodies present which interfere with the free transmission of the rays of light. If the solution were simply coloured, but were free from solid bodies, it might look dark in colour, but still it would be transparent and bright. The refiner, then, has first to get rid of this solid matter, and the obvious plan is to pass it through a filter in the same way as I clarified a solution the other day, by passing it through a folded filter-paper. But all these fluffinesses tend very rapidly to choke up the pores on any filter on which you can pour the solution, and accordingly it becomes very difficult to clarify the liquid simply by filtering. The difficulty is very often got over by a method which you have all heard of, and I dare say thought very nasty, I mean by the use of blood. Blood consists of two parts. When it is first drawn from the animal, if it is allowed to stand quietly by itself, it soon sets into a sort of clot; that arises from the passing of one constituent of the blood into a solid form; the fibrin, as it is called, becomes solid, and binds the whole mass into a clot—that is, if the blood is allowed to stand still. If fresh-drawn blood be stirred, the fibrin collects in a sort of thread, whence its name, and this can be all withdrawn from the mass, leaving behind a solution, somewhat coloured, of the other constituents of the blood, among which albumen, that is, the same body as the white of egg, is the most important. I am going to show you the effect of putting this defibrinated blood into a solution of sugar. I might have used white of egg in the same way, but blood being more generally used (except in Russia), I thought I had better use it on this occasion, when you will see its effect in clarifying the solution. The solution ought to be at a temperature of about 120° or 140°. You can anticipate what will occur if we mix a solution containing solid particles either with white of egg stirred up with water or with this albuminous portion of the blood, and then heat the liquid to near the boiling-point. You know that white of egg sets when it is heated. If I mix, therefore, albumen of the blood with this solution of sugar, and then heat it up to the point at which the albumen will coagulate, there will be a sort of network of solid albumen formed, and that will entangle every particle of foreign matter in the solution, and, at the same time, there will be bubbles of air enclosed in it, and the mass will float up to the surface, forming a sort of scum. As it comes to the top it will carry with it the solid impurities contained in the sugar. I am now using a larger quantity than is used practically in sugar refining, for only two or three buckets full are used for several tons weight of sugar. After heating the solution to the temperature at which the albumen will coagulate, I will strain off the liquid, and I think we shall find that it will be, though still coloured, clear and transparent. When this has been performed in the "blow up" pans, as they are called, and the liquid has been blown up and clarified in this way, the scum has to be separated from the liquid. This

* The Cantor Lectures, delivered before the Society of Arts.

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cannot be done on a large scale by allowing the mass to stand, and straining the liquid off through a pipe, but another and more perfect mode has to be adopted. That is done by pressing the whole contents of these "blow up" pans through a series of bags made of twilled cotton cloth, each of which is placed inside another case of very coarse hemp material, which simply serves to hold the bag together, and being much smaller than the inside bag, causes the surface of the latter to lie in folds, which present a large filtering surface. On the table there is a specimen of one of these bags with its case; one end is attached to a pipe, through which the liquid runs down and fills the bag below, and passing through the folds of the bag, it runs out clear, leaving all solid matter behind. The liquid that passes through these bags is, of course, highly coloured, if it is a solution of anything like ordinary raw sugar. There is a specimen on the table of the result.

The liquid now passes into a series of iron cisterns, where it remains until it is wanted. When almost boiling hot, it is run into the top of an iron cistern, like a large steam boiler turned on end—a vessel made of cast-iron, perhaps 20 feet high by 7 in diameter, and capable of holding from 15 to 20 tons of animal charcoal. The liquor runs into the top of this cistern, which is nearly filled with animal charcoal, and gradually percolates downwards through it.

Now, I have shown you already one action of animal charcoal. You recollect that when a solution of dextrine passes through a column of animal charcoal it loses its dextrine, and the solution of sugar in passing through the animal charcoal loses in like manner portions of the albuminous and gummy matters contained in it. But now I wish to show you another action which is very remarkable, and far more striking at first sight than the one I have mentioned. I refer to the power which animal charcoal has of absorbing from a solution many vegetable colouring matters. For the purpose of exhibiting this power, I will choose a solution of indigo, and show you its effect. The sugar, in passing through this column of animal charcoal, loses, in great part, the colouring matters which it originally had, and, at the same time, as I told you, some of the less visible but somewhat more important bodies of a gummy nature. Here are two solutions, one before going through animal charcoal, and one after, and you see the difference, though I have taken a not very favourabe specimen, because the liquor had been running through for some time, and, therefore, the decolourising power of the charcoal had become to some extent exhausted. It is a very important matter to the refiner to get the solution of a good colour, and therefore great care is taken in this process. Now, to show you the effect of the charcoal on the solution of indigo:—I might have chosen caramel, which is, practically, burnt sugar, or many other colouring matters, such as cochineal, and it would have shown the same result. On putting into this solution of indigo some powdered animal charcoal, and boiling the two together for some minutes, and then filtering the liquid, you see that the charcoal has removed the colouring matter to a very considerable extent; and the same effect is produced on the sugar liquid on passing it through these large charcoal filters.

From these charcoal filters, the liquor, which is now almost colourless, passes to a vacuum pan, the mode of action of which I have already described. The solution is concentrated there until it becomes a supersaturated solution. It is then caused to crystallise, and the crystals are made to grow in size by the admission of fresh portions of the liquor into the pan from time to time, and the evaporation of the water belonging to that liquor, until the pan is nearly filled with a mixture of grains of sugar floating in a hot saturated solution of sugar, *plus* the impurities which still remain. When the "boiler" judges that the mass in the pan is of sufficient strength, he stops the process of evaporation by simply shutting the valve communicates with the air-pump, and causes the boiling to cease. He then allows the temperature of the mass to rise some 20 or 30 degrees. Now, what is the effect of raising the temperature? As I have stated, and shown to you by experiments, water has a point of saturation for every soluble solid at each degree of temperature, and, as a rule—at any rate it is the case with sugar—the higher the temperature, the more of the solid matter will dissolve. Now, we had here a mass of crystals floating in a syrup, saturated at a temperature, say, 150° F. Now, on raising the temperature of this mass, the water present in the syrup becomes capable of dissolving an increased proportion of sugar, and accordingly some small portion of these grains, or small crystals, passes again into solution; the syrup becomes more concentrated at the same time that it becomes hotter. This heated magma of crystals and syrup is now filled out as rapidly as may be into a series of moulds, which vary in size in different refineries. I have here a specimen of one of the smaller size, the shape of which will be familiar to you; they have an opening at the bottom, which can be readily closed or opened. In these moulds the mass is allowed to stand for a couple of days or so; first it stands for twenty-four hours, when it becomes entirely set into a hard cake. How is it caused to set?

(To be continued).

MISCELLANEOUS.

Royal Dublin Society.—Dr. Emerson Reynolds read a paper on Monday evening, the 19th ult., "On Coal-Gas and its Flame." The lecturer referred to Sir H. Davy's theory of the luminosity of flame, and Professor Frankland's later theories. The lecturer was of opinion that more reliance should be placed upon the latter. The lecture was illustrated by numerous experiments.

Royal Geological Society of Ireland.—The Annual Meeting of this Society was held on Wednesday, the 14th ult., in the Museum Buildings, Trinity College. Dr. Alexander Macalister was elected President, in room of the Earl of Enniskillen, who had resigned. After the election of the Council and other routine business, Mr. Edward Hull, F.R.S., read a paper "On a Remarkable Fault in the New Red Sandstone of Rainhill, Lancashire."

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition o the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, February 5, 1872.

In addition to several important memoirs and papers relating to mathematical, mechanical, astronomical, and other sciences, and a very exhaustive report on aërial navigation, this number contains the following original papers and memoirs relating to chemistry:—

Researches on Fermentation.—E. Fremy.—The second instalment of this lengthy monograph, the contents of which are, notwithstanding its very high intrinsic merits, not suited for useful abstraction.

Laws Governing the Motion of the Flow of Liquids in Capillary Space (Espace Capillaire).—E. Duclaux.—An algebraico-physical paper.

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Chemical Studies on the Landes of Brittany.—A. Bobierre.—The contents of this paper, although mainly of local interest, throw some light on the causes of the sterility of the soils here termed *landes*, that is to say, barren sandy moorlands bearing only imperfect plants of a stunted growth, heather and the like. It appears that the cultivation of fir-trees, *Pinus maritima*, and other species is beneficial for bringing such soils into a different mechanical as well as chemical condition, and thereby afterwards suited for tillage.

Contraction which Solutions of Cane Sugar Undergo at the Moment of Inversion, and on a New Saccharometrical Process.—Dr. G. Chancel.—Reserved for full translation.

Analysis of Linseed Oil.—Dr. Sacc.—By saponification with oxide of lead, 100 parts of oil gave 6 of glycerine and 102 of fatty acids, 94 per cent thereof being oleic acid, and the remaining 8 margaric acid. The author evidently has not taken any notice of the very minute and exhaustive researches on drying oils made some twelve years ago by Dr. G. J. Mulder, who published a monograph on this subject. The main constituent of linseed and other so-called drying oils is linoleine, $3(C_{32}H_{27}O_3),C_6H_8O_3$ (see CHEMICAL NEWS, vol. xxiv., p. 299).

This number contains two papers by different authors on the spectrum of the aurora borealis observed on February 4 last.

Journal für Praktische Chemie, No. 20, 1871.

This number contains the following original papers and memoirs:—

On Nitroso-Diethyline.—A. Geuther.—This paper treats in the first place on the action of strong alkalies upon nitroso-diethyline, against which this substance is indifferent at temperatures below 155° when treated along with either aqueous or alcoholic potassa solution in a sealed tube; at the temperature alluded to, decomposition ensues, accompanied by the formation of ammonia, ethylamin, and nitrogen, while, the potassa having become simultaneously carbonated, the nitrosyl group was destroyed, and its oxygen employed for the oxidation of C_2H_5. The process may be elucidated by the following formula:—

$$4[(C_2H_5)_2NO.N]+8KOH=4(C_2H_5.H_2N)+2NH_3+C_2H_4+2N+4CO_3K_2+3OH_2.$$

Next, the action of reducing agents, sulphuretted hydrogen, ammonium hydro-sulphide, ferrosulphate and bisulphite of soda, were tried as regards their action upon nitroso-diethyline; even up to a temperature of 150° these reagents do not act upon the body just mentioned, but sodium amalgam acts in the presence of water most energetically upon nitroso-diethyline, the result being the formation of diethylamine and protoxide of nitrogen, according to the following formula:—

$$2[(C_2H_5)_2.NO.N]+4H=(C_2H_5)_2HN+N_2O+OH_2.$$

Dry hydrochloric acid gas acting upon nitroso-diethyline converts it into diethyl-ammonium chloride and probably nitrosyl chloride, according to the following formula;—

$$(C_2H_5)_2.NO.N+2HCl=(C_2H_5)_2H_2NCl+NOCl.$$

Composition of Hydrate of Antimonic Acid.—A. Geuther.—The results of the author's researches are—(1). That the thoroughly air-dry hydrate is neither per-hydroxy nor mono-hydroxy acid, but trihydroxy-antimonic acid. (2). When this acid is heated to 175°, there is driven off as much water as will leave a mono-hydroxy acid, which (3) when heated to 275° yields antimonic-acid-anhydride, which, again, when heated to 300° yields, while oxygen is given off, antimonious-antimonic-acid-anhydride.

Decomposition of Chloride of Phosphorus by Water.—A. Geuther.—After briefly referring to Dr. Kraut's researches on this subject, published in the *Ann. d. Chem. u. Pharm.*, clviii., p. 333, the author records the results of a series of experiments, from which it appears that Dr. Kraut's statement, that, by the contact of chloride of phosphorus and boiling water, amorphous phosphorus is separated, is not correct, but otherwise the results of the experiments of Dr. Kraut are fully confirmed.

Action of Sodium Alcoholate upon Benzoic-Acid-Ether.—A. Geuther.—Sodium alcoholate free from alcohol, when heated along with benzoic-acid-ether to 160° for a considerable time, yields chiefly sodium benzoate and ordinary ether, according to the formula—

$$C_7H_5(C_2H_5)O_2+C_2H_5NaO=C_7H_5NaO_2+(C_2H_5)_2O;$$

but, at the same time, there are three by-products formed, which, according to the researches published in this paper, are formic acid, a liquid boiling at 200° ($C_{26}H_{24}O_3$), and another liquid boiling at 360° ($C_{27}H_{26}O$); these fluids are neutral oily substances.

Action of Phosphoric Chloride upon Anhydrides and Chlorides.—Dr. A. Michaelis.—This essay is divided into the following sections:—Phosphoric chloride and sulphurous anhydride; phosphoric chloride and sulphuryl-hydroxyl chloride; phosphoric chloride and pyro-sulphuryl chloride, chromacichloride, potassium bichromate, antimonious-acid-anhydride, antimonic-acid-anhydride, oxide of bismuth, oxide of lead, peroxide of lead, oxide of tin, oxide of copper, oxide of mercury, molybdic acid, and tungstic acid.

Chemical Retrospect of the Year 1871.—Dr. Kolbe.—The eminent *savant* shows in this paper that he is not only thoroughly well acquainted with science, but also with the conditions existing in different countries; his allusion to the United Kingdom, while courteous and complimentary towards its men of science, contains a very true and correct view of the disdainful contempt with which science in general, and chemistry especially, is treated in certain quarters.

Polytechnisches Journal von Dr. E. M. Dingler, first number for January, 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Chemistry of the Devitrification of Glass.—Dr. H. E. Benrath.—After first briefly referring to the observations of Réaumur (150 years ago), and to the later researches made on the devitrification of glass by Dumas, Pelouze, Terreil, and others, the author (a practical glass manufacturer) gives a detailed account of his experiments and analysis of different kinds of glass before and after the devitrification. The author concludes this very exhaustive essay by stating that, in his opinion, the behaviour of glass before and after devitrification is, that the silica in glass is not so much in the condition of three- or four-fold combination as in that of solution in glass (perhaps $RO,2SiO_2$), and then, as is the analogous case with all solutions to different temperatures, correspond different maxima of dissolved substance.

Generation of Electricity in the Electric Chain (Kette), and its Relation to the Chemical Process.—H. Rheineck.—The first instalment of a very lengthy essay on this subject. The contents are, however, notwithstanding their high scientific value, not suited for useful abstraction.

Researches on the Formation of Aniline Red.—Dr. Rosenstiehl.—The contents of this essay may be summarised thus: (1) pseudo-toluidine, heated by itself to 170° along with arsenic acid, is partly converted into pseudo-rosaniline; (2) this conversion takes place at the ordinary temperature when either pseudo-toluidine by itself, or its salts, are acted upon by the air; (3) it is this behaviour which causes the sensitive colour reaction of pseudo-toluidine, which reaction is not interfered with by the presence of either toluidine or aniline; (4) the formation of pseudo-rosaniline frequently occurs in the process of the generation of aniline black, and is in that case a great inconvenience; (5) by the dry distillation of indigo with an alkali, a mixture of aniline and pseudo-toluidine is obtained.

Action of Bone-Black in the Process of Sugar Refining.—E. Wernekinck.—The contents of this lengthy essay bear mainly upon practical matters relating to sugar refining.

Contrivance for Rapidly Determining the Quantity of Starch Contained in Potatoes.—Dr. A. Schwartzer.—This paper treats on a subject which is not much attended to in this country—to wit, the good quality of potatoes as ascertained by their specific gravity—it being a well-known fact that the more starch (the main constituent of this tuber) potatoes contain the higher their specific gravity. The author describes at length a contrivance (weighing machine of simple construction) with the aid of which samples of potatoes (quantities of at least 5 kilos. together) can be conveniently tested for their specific gravity.

A Mixture Suitable for Lucifer Matches, and not containing Phosphorus.—W. Jettel.—Percentically—Glass, 8·77; glue, 7·12; bichromate of potassa, 5·59; chlorate of potassa, 46·76; oxide of iron (brown umber, Fe_2O_3), 4·03; manganese, 13·07; sulphur, 7·41.

Prize Essay on Sugar Manufacture.—The East Bohemian Association of Sugar Manufacturers intends to give a sum of £50 for the best essay on sugar manufacture. This work must consist of two sections. The first section, chemico-technical, to contain—(*a*) Well-made and complete researches and analysis of all the raw materials used in the process of sugar manufacture; (*b*) complete analysis of all the products obtained in this manufacture; (*c*) a succinct and explanatory description of the chemico-technical operations required in the sugar manufacturing process; (*d*) a complete collection of all the tabulated forms required to assist the making of calculations for the various manipulations; (*e*) a brief, yet complete, description of the sugar manufacturing process, beginning with the washing of the beet-roots and ending with the refined produce. The second section, mechanico-technical, should treat, in full details, on the plant and machinery required, on the management of the operations, and on the means to be employed for keeping the plant and machinery in good repair. Competitors should send their essays to Herrn Fr. B. Goller, Manager of Sugar Works, at Podebrad, in Bohemia. The essays ought not to contain the names of the authors, which should be sent in a sealed note bearing on the envelope a motto, also to be placed on the fly-leaf of the essay. The jury to judge on these essays is to consist of a mixed scientifico-technical committee of six members.

Zeitschrift für Chemie von Beilstein, No. 16, 1871.

This number contains the following original papers and memoirs:—

Action of Alkaline Bisulphites upon some of the Diazo Compounds.—P. Römer.—By treating a concentrated aqueous solution of bisulphite of potassa with nitrate of diazo-benzol gradually added while in aqueous solution, the author obtained a crystalline compound which, after having been dried at 120°, was found on analysis to yield results leading to the formula $C_6H_7N_2SO_3K$, while the formation of this salt is elucidated by the following formulæ:—

$$C_6H_5N_2O_3:2HKSO_3:H_2O=C_6H_7N_2SO_3KH_2SO_4,KNO_3.$$

The author tried to obtain the free acid by treating the potassa salt here alluded to with hydrochloric acid, but he did not thus obtain well-defined crystals. By double decomposition, the baryta salt was prepared. When a solution of the potassa salt alluded to was added to a solution of nitrate of silver, metallic silver was instantaneously thrown down, while the liquid becomes yellow-coloured, and yields, by careful evaporation, a silver-salt which becomes blackened at 100°; the formula of this compound is $C_6H_6NSO_3Ag$. Diazo-benzol-sulpho

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acid, $C_6H_6N_2SO_3$, behaves with bisulphite of potassa in an analogous manner, yielding a potassa salt of a new acid, $C_6H_8N_2SO_3$, the formation of which is elucidated by the following formulæ:—

$$C_6H_6N_2SO_3 : 2HKSO_3 : 2H_2O = C_6H_8N_2SO_32KHSO_4.$$

The acid decomposes carbonates, is readily soluble in boiling water and sparingly so in alcohol and cold water; the constitutional formula of this new acid is—

$$C_6H_4\begin{cases}NH—NH_2\\SO_3H\end{cases}$$

Some of the Derivatives of Lepiden.—N. Zinin.—The first product of the oxidation of lepiden, $C_{28}H_{20}O$, is oxylepiden, $C_{28}H_{20}O_2$; when this compound is treated with a solution of chromic acid in glacial acetic acid, there is formed, by the aid of heat (70°) dioxylepiden, $C_{28}H_{20}O_3$, a solid crystalline body, fusing at 157°, soluble in boiling alcohol at 95 per cent (1 part of the substance requires 24 parts of alcohol), soluble in the same proportion in boiling glacial acetic acid. Chromic acid converts dioxylepiden into benzoic acid and benzyl; reducing agents have no action at all on dioxylepiden, while the oxylepiden is thereby again converted into lepiden. When treated with weak alcoholic solution of caustic potassa, dioxylepiden is converted into desoxybenzoin and benzoic acid—

$$C_{28}H_{20}O_3 + 2KHO = C_{14}H_{12}O + 2C_7H_5KO_2;$$

hence the rational formula of dioxylepiden is $C_{14}H_{10}(C_7H_5O)_2O$.

Oxidation of Tertiary Alcohols.—A. Boutlerow.—After first referring to his former treatise on this subject, the author now records at length another series of researches on the oxidation and mode of progress of oxidation of the tertiary alcohols. Dimethyl-ethyl-carbinol yields, by oxidation, acetic and carbonic acids; dimethyl-propyl-carbinol yields acetic and propionic acids; methyl-diethyl-carbinol yields acetic acid; triethyl-carbinol yields acetic and propionic acids; trimethyl-carbinol yields aceton, acetic, propionic, and iso-butyric acids; while dimethyl-pseudo-propyl-carbinol yields pseudo-propyl and aceton. The author further states that tertiary alcohols which contain the phenyl group will yield, by oxidation, benzoic acid, since in these the C-atom will be eliminated along with the most complex (also the most stable) alcohol radical.

Cinnamic Acid.—F. Beilstein and A. Kuhlberg.—This essay is divided into the following sections:—Purification of cinnamic acid; nitro-hydro-cinnamic acid; para-nitro-hydro-cinnamic acid; salts and ethers of this acid; nitro-cinnamic acid; para-nitro-cinnamic acid; salts and ethers of this acid; β-nitro-phenyl-chloro-lactic acid.

Action of Chlorine on Isopropyl Chloride.—C. Friedel and R. D. Silva.—Very pure isopropyl chloride was submitted to the action of chlorine, aided by direct sunlight, and the fluid next treated by fractional distillation, resulting in the yield of methyl-chlor-acetol and propylen chloride; the former predominates, while, as regards the latter, its quantity varied from two-thirds to one-fifth of that of the former.

Annalen der Chemie und Pharmacie, December, 1871.

This number contains the following original papers and memoirs:—

Valerianic Acids of Different Origin.—E. Erlenmeyer and C. Hell.—The contents of this very extensive memoir are not suited for abstraction; we quote the headings of the different sections—Introduction, containing a clear and concisely-written review of all the scientific researches on this subject; valerianic acid from isobutyl cyanide; valerianic acid from valerian root; valerianic acid from amylic alcohol; valerianic acid from optically-active amylic alcohol; valerianic acid from leucine; experiments made with the view of obtaining optically-active valerianic acid; behaviour of inactive and active valerianic acid by oxidation.

Water Contained in Wells Situated in Towns and Populous Places.—Dr. C. Aeby.—This essay on water analysis, to which are appended the results, exhibited in tabulated form, of a series of experiments chiefly made with water at Bern, is mainly of local interest only.

Animal Cellulose.—Dr. Schäfer.—The results of this very lengthy essay, containing the detailed account of a series of chemico-physiological researches, may be summarised as follows:—In the first place, animal cellulose exhibits a greater resistance to the action of chemical reagents, but otherwise agrees with vegetable cellulose in the following properties and reactions:—Percentage composition; becoming blue-coloured by iodine, after having been first treated with sulphuric acid; solubility in ammoniacal oxide of copper, from which it is again precipitated by acids (the precipitate thus obtained is, however, physically changed to a certain extent, viz., as far as is concerned solubility in dilute hydrochloric acid, and also becoming tinged with iodine); conversion into fermentable sugar by longer action of sulphuric acid; conversion into a nitro body by the action of very concentrated nitric acid, the resulting substance sharing the properties partly of collodion, partly of gun-cotton.

Occurrence of Chondrigenous Substance in the Tunicatæ (Class of Lower Animals, Molluscs).—Dr. Schäfer.—From the researches recorded in this paper we learn that in the tissues of this kind of animals a substance is met with which, in its properties and reactions, and also in the percentage of nitrogen it contains, corresponds very closely to chondrine.

Another Instance of the Occurrence of Inosite (a Kind of Sugar) in the Vegetable Kingdom, and Conversion of that Substance into Paralactic Acid.—Dr. Hilger.—After briefly alluding to the discovery of inosite by Dr. Scherer in the muscular tissue of the heart, and the extensive researches of a great many *savants* on this substance (also met with in certain plants), the author records at length his researches, by which he has been enabled to ascertain the presence of inosite in grape-juice, and, further, the conversion of this substance into paralactic acid under the influence of decaying cheese, while simultaneously propionic acid is formed. As a confirmative proof that the lactic acid obtained is paralactic acid, the author oxidised it with chromic acid, thereby obtaining malonic acid, the silver-salt of which, $C_3H_2Ag_2O_4$, was analysed.

Presence of Paralbumen in Serous Transudations.—Dr. Hilger.—By paralbumen, the author designates a modification of serum-albumen, the alcoholic precipitate of which is soluble in water, and only partially coagulated by the addition of small quantities of acetic acid; this paralbumen has been hitherto only found in the hydropical ovarian cysts, but the author has recently found it also in the fluid abnormally secreted in ascites.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, January 18, 1872.

Studies on the Iron Ores of some of the Metallurgical Districts in the Eastern Parts of France.—M. Letaud.—By the recent events France has lost all its iron industry in what were its eastern districts, and the contents of this paper treat really on the iron ores of the Grand Duchy of Luxemburg, where, as is well known, very extensive and valuable iron ore deposits are found. The author gives an excellent review of this subject, elucidated by a large number of results of analysis of ores, made by Drs. Kerkhoff and Reuter.

Eolipile, Vapour-Lamp, Constructed to Burn the Vapours of Petroleum Spirit and other similar Fluids for Laboratory Use.—Dr. Debray.—Illustrated by woodcuts. An excellent contrivance for use where gas cannot be had.

Application of Dynamite for Boring Artesian Wells.—Dr. Hamel.—The account of some successful experiments made in Denmark.

Bibliography.—Under this heading we notice—"De la Conservation de la Viande et autres Substances Alimentaires par le Froid et la Dessiccation," par M. Ch. Tellier; ouvrage nouveau contenant 108 gravures, 12 planches, et 3 cartes; chez l'Auteur, 99, Route de Versailles, Paris-Auteuil. From the very lengthy review here given, it appears that the contents of this work merit general attention not only in France but everywhere, since the subject of suitably preserving animal and other food is of the highest importance also in a commercial point of view. "La Ferme et les Champs," par M. E. Vianne; un fort volume, 550 pages et 375 gravures, prix 6 francs; A. Sagnier, Editeur, 7, Carre four de l'Odéon, Paris. An excellent and very well-written book on agriculture and what relates to it—implements, horses, cattle, &c.

La Revue Scientifique de la France et de l'Etranger, February 17, 1872.

This number does not contain any original papers on chemistry, but from a brief *resumé* of the proceedings of the meeting of the Chemical Society of Paris, held on the 2nd of February last, we note here that Drs. C. Girard, Lauth, and Jungfleisch, having repeated the experiments of Drs. Dusart and Bardy (CHEMICAL NEWS, vol. xxv., p. 81), find that even at 340° no such reaction ensues, even if the experiment is continued for fifteen hours; the different bodies named *loco citato* remain qualitatively and quantitatively as they were. When we receive the *Bulletin Mensuel de la Société Chimique de Paris* we shall give a more complete account of the proceedings.

MEETINGS FOR THE WEEK.

MONDAY, March 4th.—Medical, 8.
—— Royal Institution, 2. General Monthly Meeting.
—— Anthropological, 8.
—— London Institution, 4. Prof. Odling, F.R.S., "On Elementary Chemistry."
TUESDAY, 5th.—Royal Institution, 3. Dr. W. Rutherford, F.R.S.E., "On the Circulatory and Nervous Systems."
—— Civil Engineers, 8.
—— Zoological, 9.
WEDNESDAY, 6th.—Society of Arts, 8.
—— Geological, 8.
—— Microscopical, 8.
—— Pharmaceutical, 8.
THURSDAY, 7th.—Royal, 8.30.
—— Royal Institution, 3. Prof. Odling, F.R.S., "On the Chemistry of Alkalies and Alkali Manufacture."
—— Chemical. 8. Dr. Debus, F.R.S., "On the Reduction of Ethylic Oxalate by Sodium Amalgam." Alfred H. Allen, "On Metastannic Acid, and the Detection and Estimation of Tin."
—— Royal Society Club, 6.
—— London Institution, 7.30. Paper and Discussion.
FRIDAY, 8th.—Royal Institution, 9. R. Liebreich, Esq., "On the Effect of certain Faults of Vision on Painting, with especial reference to Turner and Mulready."
—— Quekett Microscopical Club, 8.
—— Astronomical, 8.
SATURDAY, 9th.—Royal Institution, 3. Moncure D. Conway, "On Demonology."

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NOTES AND QUERIES.

Butylen Glycol.—Will any one kindly give me the equations by which butylen glycol is a condensation of or from aldehyde, just as hydrobenzoin is from benzaldide. There are many very curious questions which might be asked of M. Schiff in regard to the special elongation of the coniine atom—we forbear! But how is it that when first discovered it appeared $(C_8H_7)_3H.N$ or $C_{16}H_{13}.N$, whereas now, with a very different type of elongation, it is $C_{20}H_{19}.N$.—S. E. P.

Pearl-Hardening—Selenite.—Can any of your readers give me the following information:—What the process consists of known as "Julien's patent" for making "pearl-hardening," and if the article is superior for any uses to the article made in Derbyshire from alabaster, and what the market price per ton is for the same (pearl-hardening). Would also like to know if pure crystallised selenite is to be found in England in any quantity, and if a market could be found there for this in any considerable quantity in the rock state?—THOMAS MANNING, Boston, Mass.

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THE CHEMICAL NEWS.

VOL. XXV. No. 641.

ON SOME DERIVATIVES OF URAMIDOBENZOIC ACID:*

By P. GRIESS, F.R.S.

THIS acid, of which I gave a short description some time ago†, has the composition $C_8H_8N_2O_3$. I obtained it in the first instance from the basic compound $C_{10}H_{12}N_2O_3$, which is one of the products of the action of cyanogen of an alcoholic solution of amidobenzoic acid. Its formation takes place in the manner indicated in the following equation:—

$$\underbrace{C_{10}H_{12}N_2O_3}_{\text{Basic compound.}} + \underbrace{H_2O}_{\text{Water.}} = \underbrace{C_8H_8N_2O_3}_{\text{Uramidobenzoic acid.}} + \underbrace{C_2H_6O}_{\text{Alcohol.}}$$

Since then I have shown‡ that this acid is formed also when urea and amidobenzoic acid are cautiously melted together:—

$$\underbrace{C_7H_7NO_2}_{\text{Amidobenzoic acid.}} + \underbrace{COH_4N_2}_{\text{Urea.}} = \underbrace{C_8H_8N_2O_3}_{\text{Uramidobenzoic acid.}} + \underbrace{NH_3}_{\text{Ammonia.}}$$

A third and more advantageous process of preparing uramidobenzoic acid, that of Menschutkin‖, depends on the mutual decomposition which takes place when aqueous solutions of potassium cyanide and amidobenzoic acid hydrochlorate are mixed:—

$$\underbrace{C_7H_7NO_2HCl}_{\text{Amidobenzoic acid hydrochlorate.}} + \underbrace{CNOK}_{\text{Potassium cyanate.}} = \underbrace{C_8H_8N_2O_3}_{\text{Uramidobenzoic acid.}} + \underbrace{KaCl}_{\text{Potassium chloride.}}$$

Menschutkin has described this acid under the name of oxybenzuramic acid, but I have satisfied myself that it is identical with the uramidobenzoic acid obtained by the two first-mentioned processes.

I will not here recapitulate the properties of this acid, which are described in my former papers on the subject, and in that of Menschutkin, who has also considered the constitution of the compound. The uramidobenzoic acid is particularly remarkable for the great number of derivatives it is capable of yielding, being surpassed by but few organic compounds in this respect. It is my intention in this communication to describe several of these derivatives.

Action of Strong Nitric Acid on Uramidobenzoic Acid.

When uramidobenzoic acid, deprived of its water of crystallisation, is gradually introduced into well-cooled fuming nitric acid that has been freed from nitrous acid, it is dissolved in large quantities, and without any evolution of gas. The solution, when nearly saturated, is allowed to stand for about one hour, and then poured into a large quantity of water, taking care to avoid rise of temperature. By this means an abundant yellowish-white crystalline precipitate is obtained, having strongly marked acid properties. It is soluble in alcohol, and is easily so in ether, even in the cold, crystallising therefrom in yellowish-white needles, which have the composition—

$$C_8H_6N_4O_7.$$

In spite of their appearance, however, they are by no means homogeneous, consisting, as I have ascertained, of three different acids, all of which have the formula $C_8H_6N_4O_7$, so that they may be regarded as isomeric dinitro-uramidobenzoic acids, $C_8H_6N_4O_6 = C_8H_6(NO_2)_2O_3$. Although I have not yet been able to completely separate these acids from one another, owing to the great similarity of their properties, the following facts leave no doubt as to the correctness of this view regarding their nature:—

Decomposition of the Isomeric Dinitro-uramidobenzoic Acids by Boiling with Aqueous Ammonia.

When the solution of the three isomeric dinitro-acids in aqueous ammonia is boiled for some time, decomposition ensues, resulting in the formation of three new isomeric acids of the formula $C_8N_7N_3O_5$, as represented in the following equation:—

$$\underbrace{C_8H_6N_4O_7}_{\text{Isomeric dinitro-acids.}} + H_2O = \underbrace{C_8H_2N_3O_5}_{\text{New isomeric acids.}} + \underbrace{NHO_3}_{\text{Nitric acid.}}$$

From a consideration of the composition of these new acids, it will be evident that they may be regarded as mononitro-uramidobenzoic acids, which view is, moreover, confirmed by their chemical reactions. By taking advantage of the difference in the solubility of their respective barium salts, they may be separated from one another. The following are the particulars of their preparation:—The dilute ammoniacal solution of the mixed dinitro-uramidobenzoic acids is kept boiling for about an hour, when the decomposition may be regarded as complete. A sufficient quantity of barium chloride is then added to the hot solution, and, on cooling, a considerable amount of needle-shaped crystals separate, which consist of the barium salt of one of the new acids, the β nitro-uramidobenzoic acid. When the mother-liquor separated from these crystals is sufficiently concentrated by evaporation, another barium salt begins to separate, the quantity of which may be considerably increased by allowing the solution to stand for some hours. The yellowish-white salt thus obtained appears amorphous to the unassisted eye, but on careful inspection will be seen to consist of minute needles. The acid corresponding to this salt I propose to call α nitro-uramidobenzoic acid.

In order to obtain the barium salt of the third nitro-acid, the γ nitro-uramidobenzoic acid, the mother-liquor from the previous salt is evaporated nearly to dryness on the water-bath, and the resulting mass washed with cold water.* The residue, when crystallised from hot water, taking care to avoid too long boiling, yields the pure barium salt of γ nitro-uramidobenzoic acid in bright yellow scales.

As regards the separation of the three nitro-acids in question for their respective barium salts, this is easily effected by adding a slight excess of hydrochloric acid to the hot aqueous solution of the latter,—the acids crystallising out on cooling.

α Nitro-uramidobenzoic Acid, $C_8H_1(NO_2)N_2O_3$.—This acid crystallises in bright yellow needles or small plates, which are difficulty soluble in hot water, and but very slightly so in cold water and ether. Boiling alcohol dissolves it readily. It salts have the general formula $C_8H_6(NO_2)N_2O_3,M'$, and are, as a rule, soluble with difficulty.

β Nitro-uramidobenzoic Acid, $C_8H_1(NO_2)N_2O_3$.—This acid crystallises from its hot aqueous solution in very slender bright yellow needles, closely resembling in appearance its barium salt previously described. It is nearly insoluble in cold water, and only very slightly in hot; by boiling alcohol, however, it is taken up in considerable quantities. It is monobasic like the α acid.

γ Nitro-uramidobenzoic Acid, $C_8H_6(NO_2)N_2O_3$, is obtained in small yellow scales, which are but very slightly soluble in all neutral solvents. It is monobasic, and almost all its salts are more readily soluble than the corresponding salts of the other isomeric acids; moreover, it is readily distinguished by the decomposition which it under-

* A paper read before the Royal Society.
† *Zeitschr. f. Chem.*, 1868, p. 389.
‡ *Deut. Chem. Ges. Ber.*, 1869, p. 47.
‖ *Ann. der Chem. u. Pharm.*, vol. cliii., p. 83.

* The washing contains, besides ammonium and barium chlorides, another barium salt, crystallising in yellowish-red needles, which I shall revert to further on.

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goes when boiled with water for a considerable time. It is then gradually dissolved, splitting up in the following manner:—$C_8H_4N_3O_5+H_2O=C_8H_6N_2O_4+CO_2+NH_3$.

The compound $C_8H_6N_2O_4$ thus formed is also an acid, which will be described further on. The salts of the γ nitro-acid likewise suffer a similar decomposition when their aqueous solutions are boiled; and the substance previously mentioned in footnote, as crystallising in yellowish-red needles, is the barium salt of the acid $C_6H_6N_2O_4$, formed in this way.

Action of Tin and Hydrochloric Acid on the Isomeric Nitro-uramidobenzoic Acids.

When α nitro-uramidobenzoic acid is heated with tin and hydrochloric acid, it is reduced in the ordinary way, yielding α amido-uramidobenzoic acid,—

$$C_8H_9N_3O_3=C_8H_7(NH_2)N_2O_3,$$

crystallising in scales, ordinarily of a greyish-white colour. It is slightly soluble in boiling water, still less so in hot alcohol, and almost insoluble in ether. Its silver salt is a white precipitate, having the formula $C_8H_8N_3O_3Ag$. Its hydrochloric acid compound, $C_8H_9N_3O_3,HCl$, crystallises in scales, and is marked by its great insolubility in hydrochloric acid, even when very dilute. When the aqueous solution of the latter compound is acted upon with sodium nitrate, an azo-compound, crystallising in needles, separates, which is soluble in hydrochloric acid.

β nitro-uramidobenzoic acid also, when treated with tin and hydrochloric acid, is converted into an amido-acid, $C_8H_7(NH_2)O_3$, isomeric with that last described. This new acid, which I call β amido-uramidobenzoic acid, crystallises in white scales, rather insoluble in hot water, and extremely so in cold. Curiously enough, it does not possess the property of combining with acids, but with bases it forms salts having the general formula—

$$C_8H_8N_3O_3,M.$$

Its silver salt is a white crystalline precipitate. This new amido-acid is remarkable for its instability; boiled with hydrochloric acid or with baryta-water, it is decomposed in the following manner:—

$$\underbrace{C_8H_9N_3O_3}_{\beta\text{ amido-uramido-benzoic acid.}} = \underbrace{C_8H_6N_2O_3}_{\text{New acid.}} + \underbrace{NH_3}_{\text{Ammonia.}}.$$

The new acid, $C_8H_6N_2O_3$, thus obtained forms small white nodules, which are insoluble in all ordinary neutral solvents. It combines with ammonia, forming a salt which crystallises in difficultly soluble long needles. Its hot ammoniacal solution, when mixed with barium chloride, solidifies to a pulp of white needles, which, when dried between filter-paper, have the composition $(C_8H_5N_2O_3)_2,Ba+4H_2O$. With respect to its constitution, I am inclined to regard it as amidobenzoic acid, in which one atom of hydrogen is replaced by the group—

$$(CO)N,(C_8H_6N_2O_3=C_7H_4(NH_2)((CO)N)O_2),$$

and therefore propose to call it β amidocarboxamido-benzoic acid.

γ nitro-uramidobenzoic acid, when treated with tin and hydrochloric acid, behaves differently from either of the other isomeric acids, not yielding an amido-acid, but suffering at once a much deeper decomposition, as represented in the following equation:—

$$\underbrace{C_8H_6N_3O_5}_{\gamma\text{ nitro-uramido-benzoic acid.}} + H_6 = \underbrace{C_8H_6N_2O_3}_{\text{New acid.}} + \underbrace{NH_3}_{\text{Ammonia.}} + \underbrace{H_2O}_{\text{Water.}}.$$

This new acid, $C_8H_6N_2O_3$, which has the same composition as the β amidocarboxamidobenzoic acid just described, is not identical but only isomeric with it, and I shall therefore designate it by the name of γ amidocarboxamidobenzoic acid. It crystallises in white needles, which are almost insoluble in water, alcohol, and ether.

Action of Strong Nitric Acid on the Isomeric Nitro-uramidobenzoic Acids.

In the earlier part of this notice it was stated that three isomeric dinitro-uramidobenzoic acids were produced by the action of strong nitric acid on uramidobenzoic acid, but that their separation could not be conveniently effected, owing to the great resemblance in their properties. Any of these isomeric dinitro-acids, however, may be obtained in a pure state by dissolving the corresponding nitro-uramidobenzoic acid in fuming nitric acid, free from nitrous acid. On diluting the solution with water, the dinitro-acid is precipitated in the crystalline state. It will be seen from the following description of their properties how closely they resemble one another.

α Dinitro-uramidobenzoic Acid, $C_8H_6(NO_2)_2N_2O_3$.—It crystallises in yellowish-white needles, which are very readily soluble in alcohol or ether, but scarcely so in cold water. On the addition of barium chloride to even a very dilute ammoniacal solution of the acid, a bright yellow precipitate is produced, consisting of very small nodules, which in their turn are built up of microscopic needles or plates.

β Dinitro-uramidobenzoic Acid, $C_8H_6(NO_2)_2N_2O_3$, has the same crystalline form as the α acid, which it also closely resembles in its solubility, although it would seem to be somewhat less soluble in alcohol and ether. Its barium salt is a yellow amorphous precipitate.

γ Dinitro-uramidobenzoic Acid, $C_8H_6(NO_2)_2N_2O_3$.—This acid crystallises in yellowish-white plates or needles, which behave towards solvents in a manner similar to the α acid. Its barium salt is obtained in long slender yellow needles, when a solution of the acid in ammonia is decomposed by barium chloride, and is somewhat more readily soluble than the corresponding salts formed by the two before-mentioned acids.

It can be readily understood that when an ammoniacal solution of either of these isomeric dinitro-acids is boiled for a considerable time, that it will be again re-converted into the corresponding mononitro-acid in a manner similar to that previously described as taking place with the mixture of the dinitro-acids:—

$$\underbrace{C_8H_6(NO_2)_2N_2O_3}_{\alpha,\beta,\gamma\text{ dinitro-uramido-benzoic acid.}} + \underbrace{H_2O}_{\text{Water.}} = \underbrace{C_8H_4(NO_2)N_2O_3}_{\alpha,\beta,\gamma\text{ nitro-uramido-benzoic acid.}} + \underbrace{NHO_4}_{\text{Nitric acid.}}$$

(To be continued).

NOTES OF

DEMONSTRATIONS ON PHYSIOLOGICAL CHEMISTRY AT ST. GEORGE'S HOSPITAL.

By S. W. MOORE.

XIII.

Bone, when dry, consists of one-third organic matter, two-thirds inorganic, as phosphate of lime, carbonate of lime, and phosphate of magnesia.

Teeth contain the same materials, but in different proportions; thus the enamel contains only 2 per cent of organic matter, phosphate of lime 88·5, carbonate 8, phosphate of magnesia 1·5, and trace of fluorine.

In proportion, the older the subject the more calcareous the bones—in old age being brittle, in youth soft and bending.

Muscles contain inosin, kreatin (5 grs. to the lb.), kreatinine, fibrin, fat, sarkosin, ozmozome developed by roasting, and a matter allied to hæmatine; also syntonine.

Sweat contains about 1 per cent of solids, as chloride of sodium and urea; it is also said to contain free lactic acid, and lactates, butyrates, and acetates of ammonia and soda. Carbonic anhydride is exhaled from the skin. The skin is capable of absorbing soluble matter placed in contact with it, under certain conditions.

Horns, hoofs, hides, nails, feathers, &c., are composed of gelatin, it being from these and bones that glue is extracted.

Mucus, a viscid fluid secreted by the various mucous

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membranes, contains soluble salts, lactic acid (?), and a principle mucin, turned yellow by nitric acid, not precipitated by mercuric chloride, but coagulated by alcohol; it also contains corpuscles and a trace of fat; its use is to moisten the parts by which it is secreted.

Fœces consist chiefly of unaltered food, bile, and some excreted matters. Marcet discovered a crystallisable body insoluble in water, which he named excretinose. The average amount passed daily is 5½ ounces.

Tears are allied to sweat, containing more sodium chloride.

Cerumen, or wax, secreted by the follicles of the external auditory meatus, consists of the ordinary fats, with a trace of colouring matter.

Pigment is not formed in sufficient quantities to determine its constitution; but, from certain microscopical experiments, one would incline to suspect in some parts free carbon.

Semen, characterised mainly by the spermatozoa, has as yet yielded but little information to the chemist.

The menstrual fluid, occurring periodically, is merely altered blood; it has an acid reaction from the mucus of the vagina, is of a dark colour, and is said not to coagulate. This is untrue, as numerous cases under my observation have yielded distinct clots.

The brain has never been subject to thorough investigation; it contains about 80 per cent of water, 0·7 of albumen, cholesterine in considerable quantities, olein, stearin, serolin, and cerebric and oleo-phosphoric acids. Cerebric acid is said to be free, and also united with soda; it is white, insoluble in water, but freely so in boiling alcohol and ether; water causes it to swell up; 9 per cent of phosphorus and 2·3 of nitrogen form part of its composition. Oleo-phosphoric acid is of doubtful existence. The brain contains large quantities of phosphorus in the form of phosphoric acid in combination.

ON THE SPECTRUM OF HYDROGEN AT LOW PRESSURE.

By G. M. SEABROKE.

DURING the late summer months I have been comparing the lines given by hydrogen in the spectroscope with the lines of the solar spectrum, for the purpose of ascertaining whether any lines in the sun's chromosphere were due to hydrogen, besides those usually supposed to be due to this element. The observations are, as yet, incomplete; but as it will be some months before I can again proceed, I therefore produce the results obtained up to the present time. The experiments have been conducted in a room adjoining the Temple Observatory lately erected at Rugby. My mode of proceeding has been briefly as follows:—I use a vacuum tube containing hydrogen, and connected with a Sprengel's air-pump. The tube is of the ordinary form, having the part between the bulbs, into which the platinum wires pass, about 1-40th inch internal diameter. The pressure in the tube varied from 3 to 4 m.m. of mercury. Preliminary experiments showed that at this pressure the lines appeared most distinct; but a slight change of pressure near 4 m.m. made little alteration in the lines. There is a battery of 12 Smees to work the coil for passing the spark in the vacuum tube. The light from the hydrogen tube passed through a lens which concentrates it on the slit of the spectroscope. A dispersive power of 4 prisms of 60° was used, the arrangement of the instrument being such that the ray of light traverses each prism twice. The room is kept perfectly dark, and sunlight is reflected down from the roof by means of a heliostat. At first I tried the usual mode of comparing spectra, viz., by having the hydrogen and solar spectra side by side. I found this answer very well for the bright lines, but the faint ones could not be distinguished by the side of the bright solar spectrum. I therefore placed a very fine platinum wire in the eyepiece of the spectroscope, and brought the lines under examination into coincidence with the wire, and then passed the sunlight in, and found which black line coincided with the wire, or, where there was no coincidence, the position of the wire with respect to the black lines. I have made from ten to twenty observations on each line that I have at present examined. I have every reason to believe that the limit of error is within two divisions of Fraünhofer's scale either way. The table below gives the positions of the lines I have already compared. These I hope to examine again next year, and also to finish the remainder.

Reference No.	Position on Kirchhoff's Scale.	Relative Brightness. 10 = brightest.	Remarks.
1	694	10	C.
2	881	—	Limit of a number of close lines towards C.
3	930	5	Brightest red line, except C.
4	1014	5	Suspiciously near the chromosphere line near D.
5	1049	3	The positions of these were taken by reference to the mercury lines, and are, therefore, not so reliable as the others.
6	1061	4	
7	1119	3	
8	1533	4	
9	1621	4	
10	1876	4	
11	1943	3	
12	1991	6	
13	2065	3	
14	2080	10	F.
15	2235	4	Near here, exact place uncertain.
16	2361	6	
17	2428·5	—	Limit of a band towards F.
18	2540	2	
19	2605	3	
20	2670	3	
21	2767	—	Faint band.

On comparing the above table with the catalogue of chromospheric lines by Professor Young, published in the *Philosophical Magazine* of November, 1871, I see no sufficient signs of coincidence to lead me to believe that any of the chromospheric lines in his list are due to hydrogen, except the C and F already well known to be so due. Since I have not yet examined lines further than 2767, the "near G" (2796) and *h* lines, also known to be due to hydrogen, are not mentioned in the above list. In these experiments a spectroscope with a large dispersive and magnifying power was found to be required in order to identify the lines in the solar spectrum, so that the hydrogen spectrum became so reduced in brightness that, in order to see the fainter lines, the eye required to be kept for some minutes in the dark room, although with a spectroscope of low power the spectrum appeared very bright and full of lines.—*Monthly Notices of the Royal Astronomical Society.*

ON THE MANUFACTURE AND REFINING OF SUGAR.*

By C. HAUGHTON GILL.

(Concluded from p. 105.)

WE had a quantity of crystals of sugar floating in a very hot saturated solution. The mass becomes cold, and what happens? The hot saturated solution deposits some of the body, which it held in virtue of its heat, and this sugar deposited from the hot solution forms round the crystals and sticks them all together. It cements this

* The Cantor Lectures, delivered before the Society of Arts.

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quantity of crystals, and binds them into a firm mass. This loaf of sugar has been treated in this way. It was then sent up to the working floors; a pricker was put in to clear the opening, and the mass was allowed to drain for about two days. In the course of that time a considerable quantity of syrup has drained away from it, but, as you will notice, the sugar is by no means white. It consists of a porous mass of sugar crystals, penetrated all through by syrup. When it has drained away, it leaves an apparently dry mass of sugar, but still soft and crumbling, although sufficiently hard to bear handling. This is not pure sugar yet, there are still crystals of sugar wetted with the syrup; although it is true this syrup is purer than that surrounding the crystals of raw sugar, still it is not a solution of pure sugar. Here is a specimen of the syrup that has drained away, though it may not be a fair specimen of that syrup from this mould, as it may have come from sugar of lower quality. Still the syrup is somewhat dark coloured, and the darkness of the colour arises from the fact that when this apparently slightly coloured liquid which I showed you before, is concentrated, a good deal of the water is removed, and a large portion of the sugar forms itself into essentially white crystals, so that all the remaining colouring matter (together with all the other impurities) has become accumulated in this portion which subsequently drained away. The syrup having drained away as much as possible, the loaf consists of sugar crystals wet with a solution of sugar *plus* the impurities which had not been removed by the previous processes. The refiner then has next to remove from this so-called "green loaf" the adhering syrup which contains the impurities; and the way he does it is to replace this impure syrup by a pure one. That is effected in this way. The loaf is kept in the mould, and on the surface a saturated solution of perfectly pure sugar —at least as perfectly pure as can be obtained on a large scale—is poured. Here is a specimen of a solution such as is actually employed in the refinery for that purpose. As this solution is already saturated before being poured on the face of the mould, there is no fear of the water present dissolving any of the sugar of the loaf. It gradually percolates down, and as it goes it displaces the green syrup still adhering to these crystals of sugar. It gradually pushes that out before it, and this clear liquid, the "fine liquor" as it is technically termed, is kept running on the face of the mould until the loaf is thoroughly purged from the original green syrup with which the mass was wetted. When the workmen know that is the case, they remove the rough surface from the face of the sugar by a fitting tool, and then it is in this state, and the loaf is then perfectly white, but still wet. The loaf I showed you before was wet with the coloured syrup, that has now been replaced by the clear one, but it is still wet, and all that has to be done is to finish draining it, and then to dry it thoroughly. This drying is accomplished by putting these loaves into large chambers, heated by steam, which are technically termed stoves. Although they are always heated by steam, they are, nevertheless, called stoves, so that whenever a fire happens in a sugar-house it is always said to commence in a stove. In these large chambers, heated by steam-pipes, the loaves are kept for four or five days, until they are thoroughly dry, when they are fit for the market. There is a loaf on the table, but it has not been in the stove, the wrong specimen having been sent by mistake; it has only been drained but not dried. If it had been four or five days in the stove it would have been harder, but of course of the same quality. Of 100 lbs. weight of this sugar 99½ lbs. would consist of absolutely pure sugar; indeed, I may say there is no loaf sugar which you buy which has not over 99½ per cent of true sugar in it, so that you need not fear there is any great difference in the sweetening qualities of the various specimens of sugar, whether it be obtained from cane or beet-root.

I have now sketched an outline of the processes used in working up cane or beet-root sugar into the white loaf you see before you, but I daresay the question occurs to you, what becomes of all the syrup that has drained away. The syrup that drains away from the loaf in the first case is, as I showed you just now, somewhat lightly coloured, and contains some impurities. That is returned to the vacuum pan, and again concentrated until a certain amount of grain has been obtained in the pan. It is then allowed to stand for a few hours, and then passed into the centrifugal machine, to separate the grains from the syrup in which they float. This syrup is of course more impure than that employed, and consequently is much more sticky and darker in colour, and altogether less valuable for obtaining crystals from. However, a considerable quantity of sugar is actually obtained, but it has small and confused grains. I have here some such sugar as it comes from the centrifugal machine, and this we may take as the first product which is obtained from this syrup which has drained from the loaves. This consists of very small crystals, but if they are very small, for the same weight there must be a vastly increased surface, and as there is a greater surface, there is more room for the syrup to stick to, and, consequently, they will actually retain more syrup about them than crystals of a better quality. And not only so, but the syrup itself is more impure. Accordingly, this sugar is somewhat inferior in true sweetening power to what I showed you just now. This soft yellow sugar contains a certain amount of impurities adhering to the crystals, but still contains 87 to 93 per cent of pure sugar, and 3 to 7 per cent of altered sugar possessed of sweetening powers, the remainder consisting of 3 to 5 per cent of water, and a small quantity of salts and colouring matter. It is quite clean and wholesome, and only differs from raw sugar in having a better colour, and in being free from insoluble impurities. In sweetening power it is only inferior to loaf, *i.e.*, pure sugar, as 9 or 9½ is less than 10.

From this first soft yellow sugar a syrup has been drained away, which is still darker in colour than that which I have just referred to. This, in its turn, is concentrated, but, of course, it is a highly impure solution, and contains a great quantity of sticky bodies and salts of various kinds—common salt and gummy bodies of different kinds. Still, however, it contains sugar; therefore it is concentrated, and the liquid, which contains generally a very small proportion of grain in the pan, is allowed to stand in tanks for several days. At the end of that time, the syrup, or jelly as it is called, is filled with a number of grains of sugar. These are separated by a centrifugal machine, and there is then a second quality of brown sugar produced in this way. Here, again, you have still smaller crystals as a rule, and they are surrounded with an excessively impure syrup, so that this sugar is really much more impure than the last, as well as darker in colour. I shall have to say a word on the impurities present in it, and in this I believe I am somewhat singular in my views. I believe the sugar present is not merely pure sugar wetted with a solution or syrup, but I believe in this case some of the impurities are actually in combination with the grains of sugar. Then what becomes of the syrup from this last process? It is now so impure, and contains so large a proportion of bodies which are not sugar at all, that practically it is not worth any one's while to try and get the sugar out of it. Therefore, the syrup from this last portion, a very thick and dark-coloured body, is boiled with water, and allowed to cool, when it is called treacle. I have been asked what is the difference between treacle and golden syrup, and I may saw that golden syrup is nothing but treacle passed through animal charcoal and made a little brighter.

Now, I come to the great question of what is treacle. This was a moot point for a long time. Molasses, whether from cane or beet-root, possess very much the same properties, and the explanation of their constitution rests on the same basis. Taking refinery treacle as my example, I must first tell you what it consists of. Treacle contains, speaking roughly, about 35 per cent of true sugar, about

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30 per cent of that inverted or uncrystallisable sugar which is produced by the action of acids or ferments upon cane sugar, about 20 per cent of water, and about 15 per cent of bodies that we know little or nothing about, but which we may class under the general name of dirt, but which certainly include many salts of potash and soda. Then you may say, as it contains 35 per cent of crystallisable cane sugar, why is not that got out in a saleable form and sent into the market. Practically, it cannot be done. It is true that this solution still contains water, and we may regard the syrup therefore simply as a saturated solution of these various bodies in water, and the question is, why don't you continue the operations which were previously performed, and drive off from the treacle, by means of heat in a suitable apparatus, some of the water, making the solution into a supersaturated one, allow it to stand, and then separate the remaining mother-liquid from the crystals which were formed? Practically, you cannot do it. You have not got merely sugar and water, but other bodies which require water to hold them in solution; especially those bodies which I call dirt are mostly uncrystallisable gummy bodies and salts, and you have besides that this uncrystallisable sugar; and all these bodies require a certain amount of water to keep them in solution. If you drive off the water which is required to hold them in solution, you convert this stuff into something like hard-bake. Now, if you had a quantity of hard-bake or toffee with crystals of sugar dispersed through it, it would not be a very promising task to get the crystals out of the mass, and that is what, practically, you would have to do if you tried to concentrate the treacle much further. Evaporation has been carried to such a point that if you drive more of the water out, the impurities, or those bodies which are not sugar, will simply set solid, and prevent the recovery of any sugar crystals that might be formed, even if you could get them to form. Moreover, even if you were not to drive it to this extreme point, but merely drove off some, and so contented yourself with a very small yield of sugar, you are met by this difficulty, that when sugar is held in a solution containing alkaline salts, chlorides, nitrates, and so on, of sodium and potassium, it actually forms combinations with these salts, and these compounds are bodies which, although they do crystallise, do so with such extreme slowness that, unless you could allow the concentrated mass to stand for a very unreasonable time, it would still all remain fluid, and, accordingly, you are practically unable to win more sugar from molasses on a large scale than is actually done. Of course, in a laboratory experiment it is a different matter, and there possibly you might obtain the whole of the sugar.

I have now treated as fully as I can of the processes to which sugar is submitted in the refinery, although, as I told you, I have not been able to enter into the technical details. I have therefore only now to thank you most heartily for the kind attention with which you have listened to the remarks I have made on the various manufacturing operations connected with sugar.

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, February 20th, 1872.

E. W. Binney, F.R.S., F.G.S., President, in the Chair.

Dr. J. P. Joule, F.R.S., described some experiments he had been making on the polarisation by frictional electricity of platina plates, either immersed in water or rolled together with wet silk intervening. The charge was only diminished one-half after an interval of an hour and a quarter. It was ascertained both in quality and quantity by transmitting it through a delicate galvanometer. He suggested that a condenser on this principle might be useful for the observation of atmospheric electricity,

"*On an Electrical Corona resembling the Solar Corona*," by Professor Osborne Reynolds, M.A.

The object of this paper is to point out a very remarkable resemblance between a certain electrical phenomenon (which may have been produced before, although I am not aware that it has) and the solar corona. This resemblance seems to me to be of great importance, for the striking features of these two coronæ are not possessed by any other halos, coronæ, or glories with which bright objects are seen to be surrounded.

Until the eclipse of 1871 there was considerable doubt how far the accounts given by observers of the corona could be relied upon; but Mr. Brothers's photograph has left no doubt on the subject. In this photograph we have a lasting picture of what hitherto has only been seen by a few favoured philosophers, and by them only during a few moments of excitement.

This picture shows the beautiful radial structure of the corona, the dark drifts which intersect it, and also shows the disc of the moon, clear and free from light. I have not yet seen any of the photographs of the last eclipse, but I hear there are several, and that they show the radial structure and rifts even more distinctly than this one does, but whether they do or not one photograph is positive evidence; the absence of more simply means nothing.

The features to which I refer as those which distinguish the solar corona are—

(1). Its rifts and general radiating appearance.

(2). The crossing and bending of rays.

(3). Its self-luminosity shown by the spectroscopic observations of Professor Young.

(4). The way in which its appearance changes and flickers.

When taken in connection with the blackness of the moon's disc, which shows that the corona does not exist or owe its existence to matter between the moon and the plate on which the photograph is taken, these features show that we see on the card the picture of something which actually existed in the neighbourhood of the sun; that the bright rays which we see photographed were actually bright rays of light-giving matter; standing out from the sun an enormous distance. The rifts and general irregularity of the picture show that these rays do not come out uniformly all over the sun's surface, but that they are partial and local, in some places thinly distributed and in others absent altogether. The rays are not all of them straight or perpendicular to the sun's surface.

Such bright rays as these cannot be the result of the sun's light or heat acting on an atmosphere or matter circulating in the form of meteorites. If they are due to the action of the sun's light or heat at all it must be acting on matter distributed in the rays we see, for the sun's light and heat coming out uniformly all round would illuminate any surrounding matter, if at all, so as to show its figure.

The picture irresistibly calls up the idea of a radial emission. If it is the picture of distributed matter, that matter must exist in the form of streams leaving the sun; if it is the picture of some light-producing action, this also must exist in the form of an emission from the sun.

Such, then, are the extraordinary features of the solar corona, and, as I stated, they resemble those of an electrical corona. Any one who is familiar with the various forms of electrical disruptive discharge will recognise the general resemblance they bear to an electric brush. But to the electric phenomenon I am about to describe it is no mere general resemblance, it is an actual likeness with every feature identical.

Before describing the phenomenon I may be allowed to state how I came to notice it. It will be remembered

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that in a former communication to this Society, I ascribed the phenomena of comets and the corona to a certain electrical condition of the sun. Well, the peculiar appearance of Mr. Brothers's photograph induced me to try if a brass ball, brought into the condition I had ascribed to the sun, would give off a corona presenting this appearance.

The phenomenon is produced by discharging electricity from a brass ball in a partially exhausted receiver. To do this there is no second pole used, the objects which surround the outside of the glass probably answering to this purpose. In order to produce the desired appearance a certain relation is necessary between the pressure of the air and the intensity of the discharge. It is produced best when the receiver is a glass globe insulated on a glass stand, the ball being supported in its middle by a rod coated with india-rubber, to prevent its discharging and spoiling the effect. It is only negative electricity that is discharged into the globe. What becomes of this electricity is not clear; when a machine is used it probably distributes itself on the inside of the glass, and induces a corresponding charge on the outside. When the coil is used it must escape back, for I have had it going for hours without any variation.

There is great difficulty even when the apparatus is right in producing the corona; using a large coil I just exhausted the receiver till the pressure was equal to half an inch of mercury; then there was no appearance of a corona, but one more resembling what is seen in a Geissler tube. I then let the air in gradually, and as the pressure rose the appearance changed at first to a most extraordinary mass of bright serpents twining and untwining in a knot round the ball, then to the branches of an oak tree, and as the pressure kept increasing I gradually observed amongst the branches a faint corona, which I saw at once was what I was looking for; it was formed of pencils of light, forming a light radiating envelope round the ball, diminishing in brightness as it receded from the ball; the tree gradually died out until there was nothing left but the bright radiating envelope, out of which a bright ray would occasionally flash. The diameter of this envelope was about three or four times that of the ball. It was not steady, but flickered, so that it would appear to turn round; it consisted of pencils, or, as they are termed, bundles of rays, between which there were dark gaps. These gaps moved round about the ball; subsequently, however, by sticking sealing-wax on the ball, I rendered them definite and permanent. As the pressure of air increased, the brush became fitful, and finally ceased altogether. It was best when there was about 4 inches of mercury in the guage. By varying the action of the coil I could do with different pressures of air, and hence I assume that there is a definite relation between the intensity of the charge in the ball and the pressure of the air surrounding it under which the phenomena can occur.

The appearance is very faint; so faint that it is difficult to see it even when close to the ball, and I find that it takes some time before the eye can fully appreciate its beauty. It was unfortunately so faint that Mr. Brothers was unable to photograph it. The plate was exposed ten minutes, but there was not the slightest trace of anything on it.

This corona when compared with the solar corona has the special features—

(1). The rifts and general radial appearance, including the bending and crossing of rays.

(2). The self-luminosity.

(3). The changefulness and flickering.

There is one point in which it differs from the solar corona, but this is no more than must be expected. The shading-off of the light in the solar corona is much more rapid than that in its electrical analogue. If, however, the pressure of the air could be caused to vary so that it was denser round the ball, even this difference could be done away with.

In this experiment, then, we have actually produced all the very features which are so extraordinary in the larger phenomenon, and were there no other evidence than this that the solar corona may be electrical, it seems to me that this resemblance constitutes very strong proof. When two things existing at different times, or in different places, resemble each other perfectly, and resemble nothing else in the range of our knowledge, surely that is high probability that they are similar.

We may, however, expect, if the sun is electrical, to find some direct indications of its electricity; nor are such wanting. They are increasing every day. There is the sun's effect on the electricity of the earth's atmosphere, its magnetism, and the aurora; the connection between the sun spots and the earth, and the connection between the planets and the sun spots, as shown by M. De la Rue and Dr. Balfour Stewart. It must be admitted that there are evident signs of some influence which the planetary bodies have on the sun and it on them; which is not gravity nor the result of gravity, yet the result of heat. Almost all these signs are of an electrical character, and some are electricity itself. Moreover, electricity or electric induction is the only other action at a distance besides gravity and heat that takes place. Is it not, then, probable that this influence is electrical? Are we to reject an hypothesis which explains some of these phenomena, and may explain all, simply because we do not see any cause for the electrical condition of the sun—why the sun should be charged with negative electricity?

Should we have discovered that the sun was hot if we had waited to find out why it was hot? Surely it is sufficient to say that there is no proof that it is not electrical. We may go further than this; for if we may compare large bodies with small, then we may show a possible reason for its being electrified. When two particles of different metals approach or recede from each other they become electrified with opposite electricities. May not the sun be approaching or leaving some other body of a different material? I do not suggest this as a probable explanation, but simply in answer to those who say that it is absurd to suppose the sun can be electrified.

"*On the Electro-Dynamic Effect the Induction of Statical Electricity causes in a Moving Body—The Induction of the Sun a probable cause of Terrestrial Magnetism.*" By Professor Osborne Reynolds, M.A.

If an electrified body was placed near a moving conductor so as to induce an opposite charge in the moving body, this charge would move on the surface of the conductor so as to remain opposite the electrified body, whatever the motion might be. Suppose the moving conductor to be an endless metal band running past a body negatively charged; the positive charge would be on the surface of the band opposite to the negative body, and here it would remain whatever might be the velocity of the band. Now the effect of the motion of this negative electricity on the conductor would be the same as that of an electric current in the opposite direction to the motion of the band.

If instead of a band the moving body consisted of a steel or iron top spinning near the charged body, the effect on the electricity on the top would be the same as that of a current round it in the opposite direction to that in which it was spinning.

It might be that the electricity in the inducing body would produce an opposite magnetic effect on the top; but even if this were so (and I do not think it has been experimentally shown that it would be so), its effect, owing to its distance, would be much less than that of the electricity on the very surface of the top. If we take no account of the effect of the inducing body, the current round the top would be of such strength that it would carry all the electricity induced in the top once round every revolution. And if the top were spinning from west to east by south it would be rendered magnetic with the positive pole uppermost, that is, the pole corresponding to

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he north pole in the earth or the south pole of the ieedle.

In order to show that such a current might be produced, glass cylinder, twelve inches long and four across, was overed with strips of tin-foil, parallel to the axis, with ery small intervals between them. These strips were about inches long and ½ inch wide, and the intervals between iem the 200th of an inch. In one place there was a wider iterval, and from the strips adjacent to this wires were onnected by means of a commutator with the wires of a ery delicate galvanometer. This cylinder was mounted so iat it could be turned twelve hundred revolutions in a inute, and brought near the conductor of an electrical achine. This apparatus, after it had been thoroughly sted, was found to give very decided results. As much 20° deflection was obtained in the needle, and the direcon of this deflection depended on the direction in which the linder was turned, and on the nature of the charge in e conductor. When this was negative the current was the opposite direction to that of rotation. It may be ojected that the measurement was not actually made on ie cylinder. It must, however, be remembered that it as made in the circuit of metal round the cylinder, and iat my object was to find the relative motion of the linder and the electricity. Altogether I think it may be ken as experimental proof of the fact previously stated that a steel top were spinning under the inductive influence a body charged with negative electricity the effect would e that of a current round the top such as would render it agnetic.

The cause of terrestrial magnetism has not been the bject of so much speculation as many much less imortant phenomena. It seems to have been regarded as art of the original nature of things like gravity, and the eat of the sun, as a cause from which other phenomena ight result, but not as itself the result of other causes.

Yet, when we come to think of it, it has none of the haracteristics of a fundamental fact; it appears intiately connected with other things, and when two phenoiena have a relation to each other, there is good reason or believing them to be connected, either as parent and hild, or else as brother and sister, the one to be derived om the other, or else them both to spring from the same ause.

Now the direction of the earth's magnetism bears a arked relation to the earth's figure, and yet it can have ad no hand in giving the earth its shape, which is fully plained as the result of other causes; therefore, we ust assume that the figure of the earth has something to with its magnetism, or what is more likely, that the otation which causes the earth to keep its shape, also uses it to be magnetic.

If this is the case, then, there must be some influence at ork with which we are as yet unacquainted—some cause hich coupled with the rotation of the earth results in agnetism. From the influence which the sun exerts on is magnetism we are at once led to associate it with the use. Yet the cause itself cannot be the result of either e sun's heat, light, or attraction. What other influence, en, can the sun exert on the earth?

The analogy between the magnetism produced by a inning top by the inductive action of a distant body harged with electricity, and the magnetism in the rotating rth, probably caused by the influence of the sun, which fluence is not its mass or heat, seems to me to suggest hat the influence which the sun exerts is. If the sun re charged with negative electricity, it seems to me to llow, from what the experiments I have described tablish, that its inductive effect on the earth would be to der it magnetic, the poles being as they are.

The only other way in which the sun could act to produce fluence terrestrial magnetism would be by it own magm. If the sun is a magnet, it would magnetise the . If this is the cause the sun's poles must be oppothose of the earth. Now, it follows that such a magnetism would or might, if its materials are magnetic, be caused by the rotation of the sun under the inductive action of the earth and planets in exactly the same way as that caused in the earth by the inductive action of the sun. As the direction of the rotation is the same in both bodies, and the electricities of the opposite kind, the magnetism would be of the opposite kind also. So that on this hypothesis it is probable the sun would act by both causes.

When I first worked out this idea, I was not aware that anything like it had been suggested before; but Mr. Baxendell, after having seen my experiments, noticed a review of a book on terrestrial magnetism, to which he kindly called my attention. The author, without making any assumption with regard to the electrical condition of the sun, assumes it to act on the earth's magnetism precisely as it would under the conditions I have described; and he then proceeds to consider, not only the general features of the earth's magnetism, but all its details—and this in a most elaborate manner—and to show the explanation which this hypothesis offers for them, particularly for the secular variation of the direction of the needle. I am therefore able to speak of the hypothesis as affording an explanation of the numberless variations of the earth's magnetism, as well as of its general features.

GLASGOW PHILOSOPHICAL SOCIETY.

(CHEMICAL SECTION).

Ordinary Meeting, February 26th, 1872.

Dr. WILLIAM WALLACE, F.R.S.E., President, in the Chair.

A PAPER was read by Dr. JAMES ST. CLAIR GRAY, Assistant to the Professor of Medical Jurisprudence, University of Glasgow, "*On Certain Fallacies in the Means of Detecting some Poisons.*"

The author first treated of such metals as are precipitable by Reinsch's process, showing how they may be distinguished alike from each other and from other metals. He explained the preliminary operations resorted to by himself and the precautions to be observed, and in reference to the deposition of the suspected metals on copper-foil, he said that if after boiling the prepared fluid for half an hour no deposit should show itself on the slip of copper, it should not be inferred that arsenic, antimony, mercury, and bismuth are absent, seeing that arsenic acid, the tersulphide of arsenic, realgar or the bisulphide of arsenic, and the sulphides of mercury, do not, under certain circumstances, yield a metallic deposit by Reinsch's process. A freshly prepared solution of arsenious acid readily yields a metallic deposit by Reinsch's process, but if the solution be exposed to the air for some days it may be impossible to obtain the usual deposit of metallic arsenic owing to the conversion of the arsenious into arsenic acid, the presence of which in the solution may be proved by the formation of a brick-red precipitate, by using argentic nitrate; and the arsenic acid may be reconverted into arsenious acid by passing a current of sulphurous acid gas through the solution for two or three hours. This point is of much interest, inasmuch as arsenic administered in the form of arsenious acid may become converted in the body into arsenic acid. If of this substance a quarter or half a grain be diffused in the substance of the liver, weighing, on the average, about 4 lbs. avoirdupois, the limit of its power of producing a deposit would be exceeded, and it might thus easily escape detection. In such a case the source of error might easily and simply be removed by boiling the suspected matters with a small proportion of sulphite of sodium or potassium for an hour and a half, so as to ensure the conversion of the arsenic into arsenious acid. Then, as to the tersulphide and bisulphide of arsenic, neither of which is precipitable by Reinsch's process unless a large quantity be present. In order to obtain proof of the presence of these substances the sus-

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pected matters should be boiled with caustic potash, by which means they are brought into solution. The material is then filtered or dialysed, and the clear liquid concentrated. Nitric acid in excess is added, and the excess removed by boiling. If arsenic is present it will now be found as arsenic acid, as may be proved by precipitating with argentic nitrate; and if any other proof be required, sulphurous acid may be used to convert the arsenic into arsenious acid, when its presence may be determined by Reinsch's process, by the sulphuretted hydrogen test, by the ammonio-nitrate of silver test, or the ammonio-sulphate of copper test. When the suspected matters contain the sulphides of mercury, the method is to boil with nitric acid for half an hour, add hydrochloric acid, and proceed with Reinsch's process, the sulphides of mercury being rendered soluble and brought into a fit state for the deposition of the metal in the usual way. Having enlarged upon each of these three metals, the author proceeded to explain how each deposit may be distinguished from the others, and mentioned the circumstances which should excite doubt. In the case of the liquid tests for mercury the author stated that iodide of potassium will give no result in presence of alcohol, chloroform, or ether, although these substances do not interfere with the perfect development of any of the other tests. He urged that the production of a bright green precipitate in searching for arsenic in the humid way is not always to be implicitly relied upon, inasmuch as oxide of silver or oxide of copper may be formed in the course of the operation which very much resembles Scheele's green.

Dr. Gray afterwards gave an account of the method which he had found best in the detection of hydrocyanic acid. When certain precautions are observed he considered the vapour tests by far the best. A number of the necessary precautions were mentioned and enlarged upon. The author concluded his paper by calling attention to the detection of opium, owing to the fact that the operation of detecting that substance is perhaps more frequently called for than that of any other organic poison, and that its separation and identification are at present very complicated.

In the discussion which ensued,

The President asked if it was worth while to proceed with the ordinary chemical tests for hydrocyanic acid if the odour of the substance could not be perceived, to which

Dr. Gray replied that there were persons who had not the special faculty of perceiving the odour of prussic acid, even though their ordinary sense of smell was well developed; and in answer to Mr. Dixon, he said it would be quite possible to differentiate the metals even though two, three, or four should be deposited in Reinsch's process upon a slip of copper.

CORRESPONDENCE.

LOSS OF SODA IN LEBLANC'S PROCESS.

To the Editor of the Chemical News.

Sir,—My attention has been called to a letter from Dr. Wright, in which he criticises a paper read by me before the Chemical Section of the Glasgow Philosophical Society.

The abstract of my paper published in the Chemical News is only of the latter part of it, the first part being taken up altogether with the methods of conducting such experiments, and of sampling, and pointing out the great difficulty in obtaining perfectly accurate results in all such manufacturing operations, and the extreme care necessary in conducting such experiments generally.

It will be noticed that my results are obtained at various periods, and by different methods; in fact, these investigations have been carried on, more or less, for some years.

As regards insoluble sodium compounds, my experience has been that chalk gives more insoluble soda than Irish limestone; but I cannot speak as to the limestone used in the Lancashire district.

The expression used by Scheurer-Kestner, "cette perte semble ne pas rester beaucoup audessous de 5 pour 100 et quelquefois dépasser ce nombre," most certainly does not bear the construction put on it, that the loss "certainly is never less than 5 per cent, and often very much larger," nor could it; while his experiments (of which there are only two) show it to be less than this. Taking his figures which give black ash as containing 18·65 per cent Na, and leaving about 60 per cent of waste, we have, for his two experiments—

	Insoluble.	Soluble.	Total.
1st experiment	5·37	0·54	5·91
2nd „	3·18	1·38	4·56
Mean	4·27	0·96	5·23

If we take the total loss in the waste, which is the only way in which these results can be compared, we get the figures in the following table:—

Unger.	Kopp.*	Brown.	Muspratt.	Scheurer-Kestner.	Mactear. Lowest result.	Mactear. Highest result.	Wright.
3·41	14·02	3·24	4·81	5·23	4·40	6·96	9·05

All of these figures, except those of Messrs. Scheurer-Kestner, Wright, and myself, are mere isolated experiments, and useless for comparison; but, comparing the latter, and leaving out my lowest result (obtained in a set of tanks specially fitted up for experiment), I still think Dr. Wright's results "exceptionally high," and necessarily so under the *exceptional* circumstance specially stated by him in his paper, that "the capabilities of the plant were strained to the uttermost, so that the losses are probably the maxima consistent with remuneration;" and in this case, the "two circumstances" which might *possibly* affect my results are quite unnecessary to account for the difference between them and those of Dr. Wright.

The sampling difficulty is very well illustrated by Dr. Wright in reference to the test of the salt-cake employed in his experiments. Average salt-cake gave only 3 per cent of NaCl, or less; while the average of all used in balling process was 5·31 per cent. Daily samples were taken; and "at the end of two or three weeks, as occasion served, these daily samples were respectively mixed together and carefully analysed." Now, unless these samples were mixed in *exact proportion* to the respective quantities of good, "damaged," or "inferior" salt-cake from which they were taken (and which, evidently, in the method described was not the case), the average deduced from the various tests must be perfectly fallacious.

I have no doubt whatever as to the accuracy of Dr. Wright's results, so far as regards the particular samples which he worked on; but, as compared with others, the results are high, and as regards insoluble soda, I think exceptionally so.

I pass over the two circumstances which Dr. Wright advances to account for the difference in our results, merely stating that the effect of the sources of error which he found it necessary to "carefully guard against" are pretty well known to my junior laboratory assistant.

The NaCl in salt must not only be deduced from constant testing, but checked by the produce of salt-cake from salt, taking in stocks; but I have found it much easier to obtain an average sample of salt than of almost any of the other articles connected with the process.

While I believe it to be a well-known trade custom in Lancashire to use 32 as the equivalent of soda, this is not the case in Glasgow, nor in many of the Tyne works.

* Kopp's result, as quoted by Scheurer-Kestner, is calculated from a *single* analysis of waste, said to contain 7·40 of "sulphide of sodium," equal to 4·36 Na in the waste; but it is not stated even to be an average sample, and is only given in reference to an experiment on the action of the lime in the waste on carbonate of soda in solution.

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The statement as to trade analysts of the West of England is for them to consider; but I assert most emphatically that all ash sent out by the firm of which I am a member will bear out the invoiced strength on the basis of 31 as the equivalent of soda.

I dislike exceedingly controversy such as this, but the fact that I am taxed indirectly with ignorance sufficient to make up a standard solution to "show an increase in the yield of 3·2 per cent" must be my excuse for troubling you with this letter, which, so far as I am concerned, terminates the matter.—I am, &c.,

JAMES MACTEAR.

St. Rollox, Glasgow.

SCIENTIFIC EVIDENCE IN LAW COURTS.

To the Editor of the Chemical News.

SIR,—Dr. Bernays deserves thanks for calling attention to the subject of scientific evidence in the paper which you publish in your last number. Will you allow me to suggest a little closer analysis of the causes of error in our judicial system as applied to scientific subjects? Dr. Bernays, and others who are able and willing to lend real aid in reforming existing evils, may possibly gain something by knowing the sort of view a non-scientific lawyer may take of the province of reform. It is from this standpoint that I trespass on your space.

Two sources of mischief noticed by Dr. Bernays may, perhaps, be separately considered.

(1). The admission of the evidence of unqualified persons.

(2). The insufficient or inaccurate appreciation of evidence, and herein (amongst other things) the confusion between the value of speculation and demonstration.

On the first point, Dr. Bernays offers very intelligible relief—exclude all but specific persons. I have myself heard the statement of a medical practitioner's apprentice, that he had "tested" a knife and found blood upon it, pass unchallenged, and accepted by one of our most respected judges as conclusive proof of the fact. I refrain from speculation on the competency of the witness in this particular case; all I can say is that the point did not seem to suggest itself to Bench or Bar, though the prisoner was in other respects ably defended. The moment the court got on the verge of this *terra incognita*, the usual course of sifting evidence seemed impossible.

The second point is more difficult, and I do not see that Dr. Bernays offers any adequate relief. I observe his suggestions as to procedure, but before discussing the remedy it is worth while to consider how far it is correct to draw a generic distinction between "scientific evidence" and any other evidence.

A witness says "I saw John Smith at such a time and place." This is received, without corroborative evidence of the optical process of seeing, as evidence that John Smith was there, because the facts which connect the presence of John Smith with the statement of the witness are accorded by the tribunal.

A witness says, "I say (from calculation) that the moon at that time on that night was so situated that the wall near which John Smith was standing did not throw a shadow upon him." This would be received subject to proof of the witness's competency to make the calculation, because it would be accorded that the statement could be made from calculation, although the scientific facts and conclusions involved *might* be beyond the comprehension of the tribunal.

A witness says, "I was not present or near the spot, but I say, from a long study of meteorology, that it could not have been raining at that place at that time." This evidence would not have weight, whatever proof might be given that the witness was a scientific man and spoke from the firmest conviction. The tribunal would regard it as a mere expression of opinion, and, if there were any doubt on the subject, would require some corroborative evidence that the subject matter was one of scientific demonstration.

I think these instances will serve to show that there is no difference in kind between scientific evidence and any other evidence; and at the same time to suggest to any one conversant with scientific evidence that the great evil lies in the admission of statements of very different value as evidence of equal weight, merely because the subject is recondite and the tribunal is obliged to surrender the discriminating faculty which it exercises on subjects when the premisses are within its knowledge. Theoretically, according to our present system, the court ought to have the materials before it for verifying all the premisses and testing the conclusions in the same way that other statements are tested. Practically, from the extent of the ground involved, this is impossible; and in the end the tribunal weighs the concrete statements as made (often, as Dr. Bernays suggests, with too much respect for the audacity with which they are made), and treats them as proved or disproved without the sifting which other evidence would receive.

Now if the men having weight in science could provide the tribunals with recognised authority, which would serve as a test whether a statement should be taken as fact or as opinion, if the judge, who can usually appreciate the statements of the mathematician or the accountant, had the means at his side (whether by assessors or by submitting questions to a collateral authority) of appreciating the statements of the chemist and mechanic, the greater part of the evil might be removed. I know the line between speculation and demonstration would still be difficult to draw, but, since all statements must be taken to be on one side or other, let us have the line drawn as accurately as possible.

I make the above remarks merely to indicate the direction in which scientific men can work towards the required reform. They may (although the means of having scientific assessors now exists) have to call in the aid of the jurist before much practical good is brought about; but I think they will do far more by keeping to the narrow ground above indicated than by travelling over the whole field of Dr. Bernays's suggestions. His suggestion about written and published evidence is nothing more than a proposal to adopt as a novelty the ordinary practice of the Court of Chancery. The adoption of a body of arbitrators in nuisance cases is now open to the parties if they prefer it, and he does not suggest that it should be compulsory. The suggestion for the immunity of scientific witnesses from cross-examination *is* a novelty. But why not *all other* witnesses? This is a subject which you will hardly wish discussed at length in the CHEMICAL NEWS.—I am, &c.,

W. P. BEALE.

Lincoln's Inn, March 5, 1872.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, February 12, 1872.

This number contains the following original papers and memoirs relating to chemistry:—

Reply to Dr. Fremy.—M. Pasteur.—The meetings of the Academy have been of late in a great measure devoted to very lengthy discussions on fermentations, and replies on this subject on the part

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of different *savants;* this paper is devoted to one of these replies, but the contents are not well suited for abstraction, an observation also applying to the following memoir:—

Communication Relating to the History of Ferments According to van Helmont.—Professor Chevreul.—The celebrated *savant* gives in this memoir a very clear and concise review of the opinions of van Helmont and their scientific value.

Report on a Process of Preserving Grain in a Vacuum.—Dr. Louvel.—This exhaustive essay contains a detailed account of a series of experiments made on the large scale with the view to try the practical value of the author's process for preserving grain, ship-biscuits, and flour, and especially also preventing these articles being damaged by insects, rats, and mice, by placing the same into strongly-made iron (boiler-plate) vessels of sufficient capacity to contain 10 cubic metres (100 hectolitres, 27·512 bushels) of grain or flour, and next, after having hermetically closed the man-hole of this vessel, producing a vacuum in it by the aid of an air-pump, it being sufficient for practical purposes that the vacuum be from 10 to 12 centimetres of mercury, that is, a reduction of about from one-sixth to one-seventh of the ordinary atmospheric pressure. The results of these experiments (sufficient time having been amply given to test their real value) is satisfactory in every respect. The cost of the apparatus, including air-pump, guages, tubing, and fittings, is about £64, but one air-pump can be used for a number of these vessels. It should be observed that the quantity of grain lost or rendered unfit for human food by the ravages of insects, rats, mice, worms, &c., amounts on an average to fully 13 per cent of a crop, while, moreover, by this mode of preserving, much labour required for shovelling grain about in the granaries is rendered unnecessary.

Temperature of the Sun's Surface; Reply to the Rev. Father Secchi, S.J.—E. Vicaire.

Absorption Rays Produced in the Spectrum of Solutions of Hyponitric, Hypochloric, and Chlorous Acids.—D. Gernez.

Morphological Studies on the Various Species of Alcoholic Ferments.—Dr. Engel.—The contents of this paper, illustrated by woodcuts, record a series of morphological researches on the yeast plant, and elucidate the process of fermentation.

Observation Bearing upon M. Boussingault's Communication of Jan. 8 last, on a Saccharine Substance Met with on the Leaves of a Lime-Tree.—Dr. P. Harting.—The author first briefly refers to the communication just named (see Chemical News, vol. xxv., p. 70), and then relates that some years ago he had an opportunity to observe a similar phenomenon in his garden at Utrecht (Kingdom of the Netherlands); in this instance the author found along with the saccharine excretion a number of insects, *Aphistiliæ*, on the tree, and some of these insects were seen quite filled with the saccharine juice, which, on being submitted to chemical analysis, was found to consist essentially of cane sugar. The reading of this paper, wherein the author states that, in his opinion, the secretion of this saccharine juice is due to the punctures made by the insects alluded to in the leaves of the lime-tree, gave rise—First, to an observation of M. Boussingault, who says that Dr. Harting's opinion just alluded to is that generally accepted, but did not hold good in the instance referred to by him; he also states that the leaves of lime-trees contain a rather large amount of cane sugar. Secondly, Colonel Follie states that the phenomenon alluded to is every year observed on the lime-trees planted on the Esplanade at Metz, the abnormal secretion of saccharine matter being so strong that drops of it are continually falling from the trees, which lose their foliage very early in autumn.

This number contains a voluminous account, sent in from a great number of different places, of the aurora borealis observed on Feb. 4 last.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, January 25, 1872.

Consumption of Gas by Different Burners and under Different Pressures.—E. Lemoine.—This paper contains a concise account of some noteworthy facts in reference to gas-lighting, and to the great importance of selecting burners of good construction and suited to the average pressure of the gas supplied.

Effects of Dynamite; Procès-Verbal of a Series of Experiments made on Jan. 27 last at Fort de Montrouge.—Colonel Barbe and M. Brull, C.E.—This paper contains the record of a very interesting series of experiments made in the presence of His Majesty Don Pedro II., Emperor of Brazil, for the purpose of testing dynamite. We quote for curiosity's sake the following:—An iron-hooped, well-made, oaken cask of 2 hectolitres (rather more than 44 gallons) cubic capacity was placed in a vertical position, then filled with water, and a square hole left in the lid, the size of the hole being sufficient to admit of throwing through it a parcel of four cartridges, each containing 20 grms. of dynamite, care being taken to light the fuses previous to casting the cartridges into the water. After the explosion not a trace even of the cask was to be seen, and on the spot where it had been standing a funnel-shaped hole was formed, 4 decimetres (15·748 inches) deep.

Fire-Clay Gas-Furnace for Heating Small Crucibles.—C. Mène.—The author describes, and illustrates with woodcuts, a very neatly-made apparatus, invented by M. Wiesnegg, at Paris, for heating platinum and porcelain crucibles to a very high temperature; this portable gas-furnace is very well adapted, while, if desired, the flame can be fed by oxygen.

Lithographic Stones Recently Discovered at Menton (Alpes-Maritimes).—C. Mène.—The first portion of a memoir which contains very valuable information on the stone used in lithography in general, and more especially on that recently discovered at the locality above named, and wrought on the large scale by M. Rencurel, who has established works at Santo-Stephano-Mare for preparing this stone (which appears to be of very excellent quality) for use for lithographers.

Formation of Nitrate of Ammonia in the Process of Respiration.—Dr. Struve.—The author states that, by breathing for some moments in a large-sized beaker-glass previously moistened with water, and next rinsing the glass with some pure distilled water, this liquid will be found, by the usual tests, to contain ammonia and nitric acid. This formation of nitrate of ammonia is stated to become increased after dinner has been taken. The author is of opinion that atmospheric nitrogen is not entirely passive in the process of respiration, but it should be observed that this opinion is contradicted by the direct experiments of Drs. Regnault and Reiset.

Application of Ozone for the Purpose of Maturing and Mellowing Alcoholic Liquids—Wine, Brandy, Gin, Rum, &c.—A. Frentz.—Turning to practical account Dr. Loew's observation of the conversion of the oxygen of the air into ozone by passing a current of air over small gas-flames, the author describes in this paper an apparatus fit for causing the ozone thus generated to act upon spirituous liquids, which thereby become matured and mellowed in a very few hours; 40 to 45 hectolitres of brandy (each at 22 gallons) may be thus matured per day, at a cost of about five shillings.

Gazzetta Chimica Italiana, December, 1871.

The title-page of this number is identical with that quoted by us in our issue of Jan. 12 last, but the contents of this number differ, and on the cover is printed a notice from which it appears that the January number of this year was yet in the press on Feb. 14 last. This number contains the following original papers and memoirs:—

Historical Notes and Considerations on the Application of the Atomic Theory in Chemistry, and on the System of Formulæ Used in that Science to Designate the Constitution of Compound Bodies.—Dr. S. Canizzaro.—The continuation of a very ably written monograph on this subject.

Formation of Asparagine in Vetches.—A. Cossa.—After first referring to the researches of the illustrious *savant* Dr. R. Piria ("Studi Sulla Costituzione Chimica dell'Asparagina e dell'Acido Aspartico;" Cimento, Fascicolo di Gennaio e Febbraio; Pisa, 1846) on this subject, and to the conclusion come to by that author that the formation of asparagine was due to the fact that during the growth of the vetches daylight was absolutely excluded, the author next alludes to the researches of Pasteur on this subject (*Ann. de Chim. et de Phys.*, 1857), and then relates at length his experiments on this topic, a portion of vetches being made to grow with complete exclusion, and another portion with full admission of sunlight, in order to ascertain whether the asparagine formed in either case is in all respects identical; this identity was in all respects proved. It appears that the juice of the plant alluded to when grown with the admission of daylight contains a large quantity of a nitrogenous matter, which, by inducing fermentation, causes the decomposition of the juice very rapidly; this nitrogenous matter appears either to be entirely absent in the juice of the plant grown in darkness, or to be present therein only in very small quantity, the consequence whereof is that the asparagine met with in the juice of the vetches grown in daylight is more rapidly destroyed, and hence may have arisen what was not noticed by Pasteur, viz., that the asparagine may entirely disappear from the juice, that chemist operating upon no less than 200 litres of the fluid.

Note on Amido-Sulpho-Benzidic Acid.—L. Pratesi.—The contents of this paper treat on the subject of isomerism of this body, but, as the author admits in a foot-note, this same subject has been recently more fully and completely treated by Dr. E. Kopp.

Ozone and Plants; New Experiments.—G. Bellucci.—Notwithstanding the high scientific merits of this memoir, its contents do not admit of any useful abstraction, an observation also applicable to the following lengthy essay, elucidated by a series of complex formulæ:—

Action of Cyanide of Potassium upon Bichlor-Acetic Acid.—D. Amato.

It would appear that the December number we quoted in vol. xxv., p.22, is the November number of 1871.

Journal für Praktische Chemie, No. 1, 1872.

This number contains the following original papers and essays:—

Uramido-Nitro-Phenylic Acid and some of its Derivatives.—P. Griess.—This essay treats at great length on an acid formed by the action of fusing urea upon amido-nitro-phenylic acid—

$$C_6H_3(NH_2)(NO_2)_2O;$$

this new acid, named by the author uramido-nitro-phenylic acid—

$$C_7H_5N_4O_6 = C_6H_3\left(\begin{matrix}CO\\H_2\end{matrix}\right\}N_2\Big)'(NO_2)_2O,$$

is formed from urea and picraminic, *alias* amido-nitro-phenylic, acid, according to the following formula:—

$$\underbrace{C_6H_4N_2O_5}_{\text{Picraminic acid.}} + \underbrace{COH_4N_2}_{\text{Urea.}} = \underbrace{C_7H_5N_4O_6}_{\text{New acid.}} + \underbrace{H_3N}_{\text{Ammonia.}}$$

Uramido-nitro-phenylic acid is a solid crystalline body, difficultly soluble in boiling water, hardly at all soluble in that fluid when cold, readily soluble in boiling alcohol. When gently heated, this acid fuses, forming a yellowish coloured oily fluid; at a higher temperature it is decomposed, with a slight explosion. This acid forms with bases

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crystalline salts, which are rather difficultly soluble in water. The author describes at length the following derivatives of this acid:—Amido-uramido-nitro-phenylic acid—

$$C_7H_8N_4O_4 = C_6H_3(NH_2)\left(\begin{matrix}CO\\H_2\end{matrix}\right\}N_2\Big)'(NO_2)O;$$

the hydrochloric acid compound of the last-named substance—

$$C_7H_8N_4O_4,HCl;$$

the barium compound; amido-carboxamido-nitro-phenylic acid; diamido-carboxamido-phenylic acid.

Action of Fluid Phosgen upon some Amides.—Dr. E. Schmidt.—The contents of this lengthy and very valuable monograph are not suited for abstraction. This portion is divided into the following chapters:—Introduction; action of phosgen upon ureas; carbonyl-diurea-mercuric oxide; action of phosgen upon carbonyl-diurea; action of phosgen upon biuret.

No. 2, 1872.

This number contains the following original memoirs and papers:—

Action of Fluid Phosgen upon some Amides.—Dr. E. Schmidt.—The continuation and end of this lengthy memoir. This portion contains the following sections:—Carbonyl-dibiuret-mercuric oxide; action of phosgen upon carbonyl-dibiuret; action of phosgen upon oxamide, benzamide, and acetamide.

Researches on the Combinations of Tantalum.—R. Hermann.—This very lengthy monograph is divided into the following chapters:—On the proportions wherein the metals of the tantalum group combine with oxygen; on the atomic weight of tantalum; experiments on the preparation of tantalum and on the atomistic volume of the same; tantal-aluminium; oxide of tantalum; hypotantalous acid, Ta_2O_4; tantalous acid, TaO_2; hypotantalic acid, Ta_2O_5; tantalic acid, TaO_3; combinations of the acids of tantalum with bases; tantalum and sulphur; tantalum and chlorine; tantalum and fluorine; compounds of hypotantalum fluoride with fluorine bases.

Schlœsing's Method of Separating Potassa from Soda.—Dr. H. Kolbe.—The author records in this paper a series of experiments made precisely according to the directions given by M. Schlœsing in the *Comptes Rendus*, and, from the results obtained by the German chemist above named, it appears that perchlorate of potassa is *not* insoluble in alcohol of 36 per cent as stated by M. Schlœsing; the salt alluded to is not even quite insoluble in alcohol of 63 per cent. The author, while not desiring to declare Schlœsing's method to be quite useless, still observes that, unless some more complete and corrected description of this analytical process is given, it is not reliable for accurate analysis.

Polytechnisches Journal von Dr. E. M. Dingler, second number for January, 1872.

This number contains the following original memoirs and papers relating to chemistry and collateral subjects:—

Preparation of Pure Metallic Silver.—Dr. Gräger.—The author dissolves the alloy of silver in nitric acid, taking care to use as small a quantity as possible; the solution is then transferred to a large-sized porcelain basin, and gradually neutralised with previously-lixiviated chalk free from chlorine. The neutralised liquid is next boiled, and chalk again added to it, while boiling, until the fluid has become colourless (in order to test more accurately, a drop of the liquid is poured on a piece of white filtering-paper, and next to that drop is placed one of a solution of ferrocyanide of potassium; as long as the well-known red colouration, copper reaction, hereby ensues, chalk is added). The fluid is next filtered, to separate the carbonate of copper, and the filtrate (a solution of nitrate of silver and nitrate of lime) is again boiled, and either further treated with carbonate of lime or, better still, with carbonate of soda; the bright yellow coloured precipitate thereby ensuing, a mixture of carbonate of silver and carbonate of lime, is washed, dried, and ignited, leaving a greyish white mass of metallic silver mixed with carbonate of lime; this mixture is treated with dilute hydrochloric acid, washed with distilled water, and then fused along with borax, yielding pure silver. The bright green-coloured carbonate of copper can be be used as a pigment for painting purposes.

Industrial Preparation of Tartaric Acid.—Dr. M. Kurtz.—This excellent memoir contains a complete account of the best and most economical methods of preparing tartaric acid on the large scale from the marc of grapes and other substances, by-products of wine-making.

Application of Silicate of Soda in Soap-Boiling.—Guido Schnitzer.—The contents of this lengthy memoir bear completely upon practical soap-making.

Process of Sugar Manufacture Proposed by J. Schröder.—Dr. O. Kohlrausch.—The report on a series of practical experiments made by a committee appointed *ad hoc* to test a peculiar method of sugar-boiling and clearing.

Determination of the Degree of Colouration of Sugar Solutions.—Dr. Stammer.

Submarine Blastings Executed with the Aid of Dynamite by Order of the Imperial Royal Marine at Trieste.—L. Closse.—This paper, illustrated by woodcuts, contains very valuable information on the subject alluded to.

Les Mondes, February 8, 1872.

Aurora Borealis of Feb. 4.—Rev. Lecot (at Noyon).—The author describes in this paper the phenomenon alluded to as carefully observed by him. The aurora has been also seen at Paris, and several spectroscopical experiments have been made with great success.

Aërial Navigation.—Dupuy de Lôme.—The brief account of an aërial journey made by the author in company with fourteen others in a newly-constructed air-balloon and machinery for imparting to this balloon (ellipsoidal shaped, and a capacity of 3500 cubic metres) and the car thereto attached any desired direction and motion, independent of that which the wind or air-currents will give to the balloon. The experiment has proved a complete success in every respect; a speed of 50 kilometres (31·065 English miles) per hour could be readily obtained.

Bibliography.—Under this head we notice here—"L'Année Scientifique" (15th year), par Louis Figuier; last year this well-known book was not published; the author has filled up the gap, and, according to the reviewer (Ch. Boissay), this volume will be consulted by many with great pleasure. "Annuaire de l'Observatoire Royal de Bruxelles" (39th year), par M. A. Quetelet; this work is here highly spoken of, and particular attention called to the excellent notice on the late Sir F. W. Herschel, with whom the editor was very well acquainted. "Mise en Valeur des Sols Pauvres," par M. Alphonse Fillon; the author, an agriculturist and forester of great and long standing experience, details in this volume his valuable knowledge on the cultivation of the resinous-wood-producing trees (firs, *Abies*) as the only and best means of bringing into cultivable state arid sandy soils such as are known in France under the designation of *landes* and *bruyères*.

February 15, 1872.

The contents of this number are entirely devoted to abstracts from the *Comptes Rendus*.

Bulletin de l'Academie Royale des Sciences, des Lettres et de Beaux Arts de Belgique, No 1, 1872.

In addition to several mineralogical and palæontological papers more especially relating to Belgium, this number contains the following memoir bearing on chemistry:—

Derivatives by Addition to Itaconic Acid and its Isomers.—Dr. T. Swarts.—From the introduction to this lengthy essay we learn that as yet its author does not consider his investigation complete, but, since some papers on this same subject have been published recording investigations made by others, this portion of the author's labours are now published. We regret that the contents of this essay are, notwithstanding its very high intrinsic merits, not suited for useful abstraction, but we quote the headings of the different sections:—Action of chlorine upon citraconic acid; action of chlorine upon itaconic acid; action of heat upon bibromated itapyrotartaric acid; monobromated itaconic acid; monochlorated itaconic acid; aconic acid.

NOTES AND QUERIES.

Phosphates of Lime.—Can you assist me in answering the following queries I have received from France? 1. What are the usages of the trade (I presume they mean in what manner is this commodity sold). 2. What is the proportion usually required of tribasic phosphate of lime? 3. Would phosphates of lime, averaging 43 to 45 per cent tribasic, find a ready market for England? 4. What is the price which might be obtained for such phosphates delivered on the Quai at Boulogne?—R.R.

Pearl-Hardening—Selenite.—(Reply to "Thomas Manning.")—Pearl-hardening is artificially prepared sulphate of lime made for the purpose of being used by paper-makers in many parts of England; this article is preferred on account of being very readily kept in suspension along with the paper pulp and also for its softness. There is plenty of the various native kinds of gypsum in the United Kingdom; it would be as the proverb has it—"carrying coals to Newcastle" to bring from the United States selenite or any similar mineral to this country.

MEETINGS FOR THE WEEK.

MONDAY, March 11th.—Medical, 8.
—— Royal Geographical, 8.30.
—— London Institution, 4. Prof. John Ella, "On Elementary Music."
TUESDAY, 12th.—Royal Institution, 3. Dr. W. Rutherford, F.R.S.E., "On the Circulatory and Nervous Systems."
—— Civil Engineers, 8.
—— Photographic, 8.
WEDNESDAY, 13th.—Society of Arts, 8.
—— London Institution, 7. Conversazione. Capt. R. F. Burton, F.R.G.S., "Gleanings in Syria and Palestine."
THURSDAY, 14th.—Royal, 8.30.
—— Royal Institution, 3. Prof. Odling, F.R.S., "On the Chemistry of Alkalies and Alkali Manufacture."
—— Royal Society Club, 6.
FRIDAY, 15th.—Royal Institution, 9. Mr. J. Evans, "On the Alphabet and its Origin."
SATURDAY, 16th.—Royal Institution, 3. Mr. Moncure Conway, "On Demonology."

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THE CHEMICAL NEWS.

VOL. XXV. No. 642.

ON SOME DERIVATIVES OF URAMIDOBENZOIC ACID:*

By P. GRIESS, F.R.S.

(Concluded from p. 110).

Decomposition of the Isomeric Dinitro-uramidobenzoic Acids on Boiling their Aqueous Solution.

ALL three of the dinitro-acids are decomposed when their aqueous solutions are boiled for a considerable time, gas being evolved and new acids formed, which have the composition $C_7H_6N_2O_4$. These three new acids, from their formula and properties, may be regarded as isomeric mononitro-derivatives of amido-benzoic acid—

$$C_7H_6N_2O_4 = C_7H_4(NO_2)(NH_2)O_2,$$

their method of formation being expressed in the following manner:—

$$\underbrace{C_8H_6N_4O_7}_{\text{Isomeric dinitro-uramidobenzoic acids.}} = \underbrace{C_7H_6N_2O_4}_{\text{Isomeric nitro-amidobenzoic acids.}} + \underbrace{CO_2}_{\text{Carbonic acid.}} + \underbrace{N_2O}_{\text{Nitrous oxide.}}$$

The acid obtained in this manner from *α* dinitro-uramidobenzoic acid. which I have called *α nitro-amidobenzoic acid*, crystallises in yellow needles or prisms, which are only slightly soluble in cold water and rather difficultly so in hot; they dissolve readily in hot alcohol, but scarcely at all in ether. The barium salt forms yellowish-red needles, which are very readily soluble in water even in the cold. Dried between filter-paper they were found to have the composition $(C_7H_5N_2O_4)_2,Ba+3H_2O$.

β Nitro-amidobenzoic acid is the name by which I have designated the acid obtained from *β* dinitro-uramidobenzoic acid by the above-mentioned reaction. It is only very slightly soluble in hot water, but rather easily so in boiling alcohol, from which it crystallises on cooling in clusters of yellowish-red glistening needles or small plates. The dry acid, when gently heated, sublimes, without melting, in shining rhombic plates. Its barium salt forms bright yellowish-red prisms, often well defined, which are only slightly soluble even in boiling water. Dried between filter-paper they have the composition $(C_7H_5N_2O_4)_2,Ba+2H_2O$, the water of crystallisation not being entirely expelled below 190° C.

The *γ* nitro-amidobenzoic acid obtained from the *γ* dinitro-uramidobenzoic acid, by boiling its aqueous solution, is easily distinguished from its two before-mentioned isomerides, in being very readily soluble not only in hot water, but also in alcohol and ether, even in the cold. It crystallises in yellow prisms, which melt when heated to a brownish oil; at a higher temperature it decomposes with slight explosion and evolution of yellowish vapours. Its barium salt forms reddish-yellow needles, which are very easily soluble even in cold water, and when dried between folds of bibulous paper have the composition $(C_7H_5N_2O_4)_2,Ba+7H_2O$.

Action of Tin and Hydrochloric Acid on the Isomeric Nitro-amidobenzoic Acids.

If the isomeric nitro-amidobenzoic acids are gently warmed with tin and hydrochloric acids, they are reduced to the corresponding diamido-acids in the following manner:—

$$\underbrace{C_7H_4(NO_2)(NH_2)O_2}_{\alpha\ \beta\ \gamma\ \text{Nitro-amidobenzoic acids.}} + H_6 = \underbrace{C_7H_4(NH_2)_2O_2}_{\alpha\ \beta\ \gamma\ \text{Diamidobenzoic acids.}} + 2H_2O.$$

These diamido-acids are separated from the tin chloride. formed at the same time by the ordinary methods.

α Diamidobenzoic acid, $C_7H_4(NH_2)_2O_2$, crystallises from its solution in boiling water, in which it is sparingly soluble, in minute but well-defined short prisms, which have a greyish tinge. It is remarkable for the extremely sparing solubility of its sulphate, $C_7H_8N_2O_2,SH_2O_4$, a compound crystallising in white needles.

β Diamidobenzoic acid crystallises in pale yellow-coloured plates, which are very difficultly soluble in cold water, but rather readily so when it is hot. Its sulphate has the formula $(C_7H_4(NH_2)_2O_2)_2,SH_2O_4$, and is very sparingly soluble in hot water, although not so much as is the corresponding salt of the acid just described. It is almost entirely deposited on cooling in white, soft, shining, almost oval-shaped plates.

γ Diamidobenzoic acid crystallises in long yellowish-white needles, whose solubility closely resembles that of the two other isomeric acids. Its sulphate forms white six-sided tables or prisms, which, when dried in the air, have the composition $(C_7H_8N_2O_2)_2,SH_2O_4+1\frac{1}{2}H_2O$; they are almost as insoluble as the corresponding compound of the *α* diamido-acid. When the solution of *γ* diamidobenzoic acid in dilute hydrochloric acid is decomposed by ferric chloride, a brownish-red semi-crystalline precipitate is obtained, consisting of a new acid, which, however, I have not at present more closely investigated.

Action of Nitrous Acid on the Isomeric Diamidobenzoic Acids.

In this reaction a remarkable difference is observed between the *α* diamidobenzoic acid on the one hand, and *β* and *γ* diamidobenzoic acids on the other. When *α* diamidobenzoic acid is treated with a quantity of warm and moderately dilute hydrochloric acid, insufficient to dissolve the whole, and on cooling the filtered solution is mixed with one of sodium nitrite, a semi-solid mass of crystals is formed. These after separation of the mother-liquor are easily purified by crystallisation from hot water, with the addition of a small quantity of animal charcoal. The compound thus obtained forms long needles or small plates, which, heated in a dry state, explode. It is rather easily soluble in hot water; by long boiling it gradually decomposes, giving rise to a brown insoluble amorphous precipitate. Curiously enough it does not possess acid properties, being insoluble both in ammonia and potassa, whilst, on the contrary, it combines with the mineral acids, forming well-crystallised salts. Its hydrochlorate forms six-sided plates, which are readily soluble. Unfortunately I have not yet been able to establish the composition of this basic compound with certainty, although from a determination of the gold in its gold salt, which crystallises in dark yellow needles, I believe it to have the composition indicated by the formula $C_{14}H_{13}N_5O_4$. Its formation, therefore, would take place in the following manner:—

$$\underbrace{2(C_7H_8N_2O_4)}_{\alpha\ \text{Diamidobenzoic acid.}} + \underbrace{NHO_2}_{\text{Nitrous acid.}} = \underbrace{C_{14}H_{13}N_5O_4}_{\text{New compound.}} + \underbrace{H_2O}_{\text{Water.}}$$

It is necessary to mention that this basic compound is not formed when sodium nitrite acts upon *α* diamidobenzoic acid in the presence of free hydrochloric acid, instead of in the manner just described. In this case a brisk evolution of nitrogen takes place, and after some time the yellow solution deposits an amorphous reddish-brown acid.

As regards the behaviour of the two other isomeric diamidobenzoic acids under the circumstances previously mentioned, this is quite different to that of the *α* diamidobenzoic acid. When their solution in dilute hydrochloric acid is acted upon by sodium nitrate, a white crystalline azo-acid immediately separates, and that whether the hydrochloric acid is in excess or not. The azo-acid thus obtained from the *β* diamidobenzoic acid crystallises in

* A paper read before the Royal Society.

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short needles, which are very difficultly soluble in hot water, and scarcely at all in cold. When heated in a dry state it melts and blackens, a small portion subliming, whilst the greater part is decomposed, leaving behind a difficultly combustible carbonaceous residue. The composition of this azo-acid corresponds to the formula $C_7H_5N_3O_2$. Its barium salt has the composition $(C_7H_4N_3O_2)_2,Ba+4H_2O$, and crystallises in very slender colourless needles, which dissolve readily in hot water, but only sparingly so in cold.

The azo-acid prepared from the γ diamidobenzoic acid, although isomeric with that just described, differs considerably from it, crystallising in long hair-like silky needles, which on drying, shrink together to a felt-like mass. It is rather more easily soluble in hot water than the corresponding α acid, and when gently heated melts to a yellow oil, partial sublimation taking place at the same time; at a higher temperature it decomposes with slight explosion. Its barium salt crystallises in white needles, which are rather difficultly soluble in hot water, and very sparingly so in cold. Its composition is expressed by the formula $(C_7H_4N_3O_2)_2Ba+2H_2O$.

The formation of these two azo-acids may be thus expressed:—

$$\underbrace{C_7H_8N_2O_2}_{\beta,\gamma\text{ Diamidobenzoic acids.}} + \underbrace{NHO_2}_{\text{Nitrous acid.}} = \underbrace{C_7H_5N_3O_2}_{\beta,\gamma\text{ Azo-acids.}} + \underbrace{H_2O}_{\text{Water.}}.$$

I may add that both these acids contain water of crystallisation, which is expelled at 100° C., and at the same time call attention to their great stability, in which respect they differ very remarkably from most other azo-compounds. Finally, I would remark that three other compounds, having the same formula as these azo-acids, are already known, to which I gave the names diazobenzimide, diazodracylimide, and diazosalylimide.* They were obtained by the action of ammonia on the perbromides of the corresponding diazo-acids, as shown in the equation—

$$\underbrace{C_7H_4N_2O_2,HBr,Br_2}_{\text{Perbromides of diazobenzoic acid, diazodracylic acid, diazosalylic acid.}} + \underbrace{4NH_3}_{\text{Ammonia.}} =$$

$$= \underbrace{(C_7H_4N_2O_2)''_{H_2}}_{\text{Diazobenzimide, Diazodracylimide, Diazosalylimide.}}N + \underbrace{3NH_4Br}_{\text{Ammonium bromide.}}.$$

These bodies also form saline compounds with metals, but in their reactions, as well as in other respects, differ entirely from the azo-acids just described, rendering it certain that they have a different constitution from them.

Decomposition of the Isomeric Diamidobenzoic Acids at a high Temperature.

When either of the diamidobenzoic acids is submitted to dry distillation in a retort, it splits up into carbonic acid, which is evolved, and a yellow oil, which crystallises in the neck of the retort, thus:—

$$C_7H_8N_2O_2 = C_6H_8N_2 + CO_2.$$

The compound $C_6H_8N_2$, obtained in this manner from the α diamidobenzoic acid, is moderately soluble in hot water, and crystallises therefrom in reddish-coloured scales, melting at 140° C. It exhibits the character of a base, and forms crystalline salts with the mineral acids. It can readily be seen that the composition of this base is the same as that of the phenylen diamides described by Dr. Hofmann,† $C_6H_8N_2 = C_6H_4(NH_2)_2$; and its properties leave no doubt that it is identical with one of the latter, namely that formed by the action of reducing agents on the nitraniline prepared from substituted anilides.

The compound $C_6H_8N_2$, obtained by the dry distillation of β diamidobenzoic acid, differs not only from the base just described, but also from the phenylen diamine which Dr. Hofmann obtained by the reduction of dinitrobenzol. It is easily soluble in hot water, and crystallises therefrom in white rectangular four-sided tables or plates, which usually have a reddish tinge. It melts at 99° C., and boils at about 252° C. It is likewise possessed of basic properties, and must be regarded as a new isomeric modification of phenylen diamine. The sulphate of this base crystallises in pearly scales, the composition of which corresponds to the formula $C_6H_4(NH_2)_2,SH_2O_4+1\frac{1}{2}H_2O$, and which readily part with their water of crystallisation at a temperature a little above 100° C. Its platinum salt is precipitated in the form of brownish-red needles. When ferric chloride is added to a solution of this base in hydrochloric acid, ruby-red needles immediately form, consisting of the hydrochlorate of a new base. In a free state the latter forms bright yellow microscopic needles which are almost insoluble in all neutral solvents. I have reason to believe that it has the formula $C_{12}H_{10}N_4$, and that its method of formation is as follows:—

$$\underbrace{2(C_6H_8N_2)}_{\text{New phenylen diamine.}} + O_3 = \underbrace{C_{12}H_{10}N_4}_{\text{New base.}} + \underbrace{3H_2O}_{\text{Water.}}.$$

As one or other of the phenylen diamides just mentioned is obtained when the α or β diamidobenzoic acid is submitted to dry distillation, I fully expected that the γ diamidobenzoic acid, under the same circumstances, would give rise to a third phenylen diamine, and that this would be identical with that derived from dinitrobenzol. Strange to say, this is not the case, the phenylen diamine obtained by the dry distillation of γ diamidobenzoic acid being precisely the same as that produced in the same way from β diamidobenzoic acid.

The subjoined Table shows the characteristic difference that exists between the melting-points and boiling-points of the three isomeric phenylen diamines at present known:—

	Fusing-point.	Boiling-point.
Phenylen diamine from nitro-acetanilid and from α diamido-benzoic acid	140°	267°
Phenylen diamine from β and γ diamidobenzoic acids ..	99°	252°
Phenylen diamine from dinitrobenzol.	63°	287°

Besides the three isomeric diamidobenzoic acids which I have described in the course of this paper, a fourth acid exists, having the same composition, namely, the diamidobenzoic acid obtained by Dr. Voit* by reducing ordinary dinitrobenzoic acid with sulphuretted hydrogen, and which I have since further investigated.† I propose, at present, to retain for this the simple name diamidobenzoic acid. It is distinguished from the other diamidobenzoic acids, not only by its physical properties, but especially in not yielding a volatile organic base when submitted to dry distillation, becoming, on the contrary, completely carbonised with simultaneous evolution of ammonia. With nitrous acid also it behaves quite differently, being converted into an insoluble amorphous acid of a reddish-brown colour.

When it is considered that each of the four diamidobenzoic acids at present known are derived, at least in a certain sense, from ordinary α amidobenzoic acid, there is reason to suppose that each of the acids which are isomeric with amidobenzoic acid, namely, amidodracylic and anthranilic acid, would, under favourable circumstances, give rise to four new diamido-acids, so that it is obvious that at least twelve isomeric diamidobenzoic acids may be conceived to exist.

In the preceding notice I have confined myself to the consideration of some of the most important chemical and physical properties of the substances described; but I hope to be able to lay before the Society at a future time some account of their rational constitution and of the causes which produce the various isomerisms.

* *Zeitschr. f. Chem.*, 1867, p. 164.
† *Proceedings of the Royal Society*, vol. xii., p. 639.

* *Ann. d. Chem. u. Pharm.*, vol. xcix., p. 100.
† *Ibid.*, vol. cxxviii.

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ON A NEW HYGROMETER.*

By WILDMAN O. WHITEHOUSE.

THE use of Mason's wet-bulb thermometer as a means of hygrometric measurement, though it be admitted to be the most practically useful, and indeed the only recording instrument for the purpose, has yet this serious inconvenience, not to say defect, viz., that its indications either cease or are valueless at temperatures below 32° F.

In a conversation which the writer had with the Director of the Meteorological Office some months ago, the question arose whether anything could be suggested to remedy this inconvenience.

It was obviously inadmissible to substitute any other fluid for, or to make any addition to, the water employed for the wet bulb, as then it would cease to be a test for the purely hygrometric capacity of the air. It became therefore necessary to fall back in another direction, and to find some hygrometric body which should readily and rapidly absorb moisture from the air, and at the same time afford some means of measuring and recording the amount of such absorption.

Fused chloride of zinc or of calcium seemed promising as very active agents, absorbing rapidly on their surface, and allowing the readiest possible escape of the fluid hydrate for measurement, yet no means presented itself either of accurately measuring, regulating, or maintaining the exact extent of surface exposed for absorption; nor could the substance itself be easily renewed when required, nor, indeed, could either of these substances be regarded as wholly free from the interference of frost, as the moisture absorbed from the atmosphere at a temperature much below freezing-point may remain frozen on the surface, and become incapable of continuous measurement. It seemed essential to the accuracy and practical utility of any instrument designed for this purpose—

(1). That a fixed and invariable extent of surface should at all times be exposed for absorption of moisture.

(2). That the apparatus should be simple, inexpensive, and not inconvenient in use.

(3). That the hygrometric substance should be continuously and steadily renewable; and above all, if it were possible,

(4). That the measurement should be effected thermometrically.

No solid hygrometric substance seemed capable of meeting these requirements; but all the conditions seemed likely to be fulfilled by the use of concentrated sulphuric acid. This would admit of being spread in an exquisitely fine film over the surface of the bulb of a thermometer by means of a glass capillary syphon, of which one end should rest on the upper part of the bulb, while the other end dipped into a reservoir of the acid. A continuous supply could be maintained for any required length of time by suitable arrangements. The absorption of moisture would necessarily be attended by a rise in temperature, and this would be proportioned to the amount of hygrometric moisture absorbed; while the hydrated acid, having fulfilled its office, would fall in drops from the bulb into any tube or reservoir placed for the purpose.

An instrument has been constructed by the writer to test this principle, which has, by the courtesy of the Director of the Meteorological Office, been under observation for some weeks.

It consists essentially of three thermometers of similar construction, and used as a "wet bulb," a "dry bulb," and an "acid bulb," respectively placed side by side on a suitable frame, and read together for comparison.

The experience already gained in the use of this instrument has shown that, with a reservoir of proper construction, the supply of acid may be made continuous for any required length of time, and that, from the very slight variations of flow which occur in its action, the supply to the thermometer will be sensibly equable.

The length of the syphon, and the size of the capillary bore, together with the difference of level between the surface of the fluid in the trough of the reservoir, and the point of delivery on the bulb, will determine the rate of supply of the acid.

It is clear that either a too rapid and continuous stream of acid at the temperature of the air, or a too scanty supply, would diminish the readings; yet it is found that practically there may be a pretty wide range of variation in the supply of acid, within which no essential change in the sensibility of the instrument is noticed.

For a bulb having 1 square inch of surface one drop per minute is sufficient, though the time may range from 40 to 100 seconds without inconvenience, the time being noted, as the hydrated acid, after having fulfilled its office, falls drop by drop from the bulb.

The quantity of acid required at this rate is about 3 fluid ozs. per diem, or one imperial pint per week, which is procurable of uniform density, sufficiently pure and free from lead, at a cost of about 2½d.

The temperature of the acid in the reservoir is of course that of the surrounding air; the elevation of temperature shown by the acid-bulb thermometer is due to, and seems to be strictly a measure of, the amount of moisture absorbed by the film of acid spread on the surface of the bulb, say 1 square inch, continuously supplied in its concentrated state, and as constantly passing off hydrated.

While, therefore, this instrument is, like Mason's, intended to measure the amount of hygrometric moisture in the air, and to do so thermometrically, it yet is, in its principle and in its operation, essentially of an opposite character.

The ordinary wet-bulb thermometer is at the zero of its scale in an atmosphere of perfect saturation, and its action depends upon the amount of sensible heat absorbed and rendered latent by evaporation of the water from its surface.

The acid-bulb thermometer is at its zero in a perfectly dry atmosphere, and its action depends upon the amount of latent heat rendered sensible by the condensation of vapour into water on the surface of the bulb, and by the combination of this water with the concentrated acid.

It would appear that an hygrometer on this principle is entirely free from the action of frost; while its sensibility is so great as to be at first almost embarrassing.

This may, however, be easily regulated and toned down, if necessary, to any required range by the dilution of the acid with glycerine, a fluid which is also of itself hygrometric, though its thermal effects are far less marked than those of sulphuric acid.

It will require a most careful series of observations to elicit all the points noteworthy in the new instrument, and to determine the relative values of the wet- and acid-bulb readings, noting the behaviour of each at every part of the scale, from absolute dryness to saturation, and at temperatures ranging from 75° or 80° down to 0°.

This will be necessary before the instrument can aspire to take its place among the recognised standards of meteorological science; but in the meantime the writer has been advised to offer, at the earliest time, a brief description of it to the notice of the Royal Society.

* Read before the Royal Society.

ESTIMATION OF NITROUS ACID.

By GEORGE E. DAVIS.

As "Discipulus" has addressed a query to me on page 95 of this present volume, upon the above subject, and does not state any particular process, I suppose he wishes me to give that which is thought the best. This would be difficult to do, as each operator would advocate the use of his own system; but I will give the results of my later experiments so that the reader can form his own ideas upon the subject.

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The Chloride of Lime Process.

Standard Solution of Calcium Chloroxide.—Dilute bleaching liquor of 28° T., so that 10 c.c. contain 0·7 grm. of chlorine. This solution, if kept well-stoppered and not exposed much to the light, will keep for a long period. It should be made in quantities of 500 c.c. or a litre at a time according to the quantity used.

Indicator.—This is a strong aqueous solution of indigo sulphate.

The Process.—Take a white glass-stoppered bottle of 1500 c.c. capacity, and place therein a litre of distilled water. Add 10 c.c. of the standard solution of calcium chloroxide, and pour in the nitrous vitriol, well agitating after each addition, until the odour of chlorine is very faint; when this point is reached the acid is to be very cautiously added, a few drops at a time, until a blue colour is obtained with the indigo sulphate solution. The number of divisions of the nitrous vitriol taken and divided into 100 gives the percentage of N_2O_3, *disregarding the sp. gr. of the acid*; if, therefore, the true percentage is required the quotient must be divided by the sp. gr.

The burette I employ is Binks's form; it contains 37·4 c.c. graduated into 100 parts, commencing at the top and ending with 100 at the bottom. Binks's form is not a very delicate one to use for most purposes, but it seems admirably suited to this process, for the adhesion of strong vitriol to glass is very great, so that it is very easy to regulate the supply of acid to single drops. The tube should be allowed to stand a few minutes before reading off in order that the vitriol which adheres to the sides of the tube may descend and a correct reading be obtained.

An estimation by this method occupies less than three minutes, and is so simple that any intelligent workman may use it. In four different samples the following divisions of the burette were used:—68, 57, 84, 67, which would be equal to—

$\frac{100}{68} = 1{\cdot}47$; $\frac{100}{57} = 1{\cdot}754$; $\frac{100}{84} = 1{\cdot}190$; $\frac{100}{67} = 1{\cdot}492$

on the volume.

The α Permanganate Process.

Standard Solution of Potassium Permanganate.—Dissolve 3·163 grms. of pure potassium permanganate crystals in a litre of water. Its accuracy may be tested by weighing off 0·63 grm. of pure oxalic acid crystals, dissolving in water and adding dilute sulphuric acid, this should decolourise exactly 100 c.c. of the permanganate solution.

I have stated before that the permanganate is not immediately decolourised on its addition to a very dilute aqueous solution of nitrous acid: I ventured a part explanation which I think has a small influence upon the results, but very small, as I have found by experiment that when the nitrous vitriol is added to a very large quantity of water, that nearly the whole of the N_2O_3 exists in solution as such, even when the temperature of the water has been raised to 80° C. I have also found that the decolouration of the permanganate takes place very rapidly when the temperature of the water is raised to about 80° C., and as there is no loss of gas by mixing with the water, this process answers well where there are only traces of nitrous acid in the vitriol, or from 0·08 to 0·2 per cent by weight.

This process has also the advantage that the number of c.c. of permanganate used indicates the percentage of N_2O_3 by weight without any calculation, and as now modified is a rapid process, occupying only four minutes for its completion; the permanganate is its own indicator and it is not an expensive process.

The Process.—Weigh off accurately 1·9 grms. of the nitrous vitriol, quickly dilute with 700 c.c. of water, heat to about 70° or 80° C., and add the permanganate until a permanent rose-colour is obtained; the decimal place being then removed one place to the left gives the percentage of N_2O_3 by weight thus:—

1·9 grms. of nitrous vitriol, treated as above, required 8·85 c.c. of permanganate; this would be equivalent to 0·885 per cent of N_2O_3, and, being multiplied by the sp. gr., gives 1·540 on the volume, a system so often used in chemical manufactories.

In order to avoid weighing, 10 c.c. of the same sample of vitriol were introduced into the bottom of a flask of water at 80° C. (contents 700 c.c.), and permanganate added. 81·6 c.c. were required, which, multiplied by 0·019, gives 1·550 per cent, or, more correctly, 1·55 grms. in 100 c.c. of the nitrous vitriol. The water used for this experiment should be slightly coloured with permanganate before the vitriol is added, and the burette I prefer is Gay-Lussac's.

The β Permanganate Process.

The same permanganate solution is used as in the last process.

Take a flask of 700 c.c. capacity, containing 400 c.c. of water, heat to about 90° C., and add 100 c.c. of the standard permanganate solution; heat again, and add the nitrous vitriol from a burette until one drop takes the rose tint from the solution. The number of divisions used, divided into 100, gives the volumetric percentage of N_2O_3; I use a Binks burette also for this process; it contains 19 c.c. divided into 100 parts.

I have stated that higher results may be obtained by this process the longer the operation is delayed; this was in operating with cold solutions. When the solution of permanganate is heated to 80° C. the operation is quickly ended, and numbers are obtained which are nearly identical with the chloride of lime process, but rather higher.

The following are the results of the three processes as they now stand. For some time back I have daily used these processes side by side, and the results are very regular.

	Chloride of Lime.	α Permanganate.	β Permanganate.
1.	1·538	1·482	1·545
2.	1·562	1·496	1·567
3.	1·470	1·382	1·470
4.	1·745	1·702	1·773
5.	1·488	1·413	1·492
6.	1·190	1·113	1·204
7.	2·174	2·147	2·193

The chloride of lime process now comes slightly below the β permanganate; this is owing to the small portion of the chlorine being retained in the stoppered bottle which used to escape when the open flask was used.

"Discipulus" asks whether I have compared these processes with the Urea method? and by that I suppose he means Hart's method and Crowder's method. I have compared them, but with no definite result.

Hart's process I cannot manage at all. The following results were obtained by acting upon urea nitrate at a boiling heat with the nitrous vitriol, as recommended by Muspratt:—

Hart's method.		β Permanganate.
1st.	2nd.	
3·14	2·26	1·784
2·14	1·98	1·033

Two different trials have never, with me, come out identical when operating upon the same sample, which *prima facie* appears to be sufficient proof of its incorrectness, for when operating upon the same sample we should expect, *cæteris paribus*, to arrive at least at the same result.

I have compared the processes also with Crowder's process, but this comparison has not been satisfactory; for this process indicates nearly twice as much N_2O_3 as appears on testing with permanganate or chloride of lime. Which process is at fault I cannot say at present, but I suspect the *nitrate* of urea of not giving accurate results, and although it may depend upon a reaction "which is perfectly definite and constant," as stated by Mr. Crowder, yet the cause of this difference ought to be perfectly

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understood. It is a problem which I have set myself to solve whenever I have an opportunity of performing the experiments.

There are several objections to this latter process which tend to make it a slow one; it necessitates three weighings. The apparatus after being heated is allowed to cool, which operation takes time, and the expense of urea nitrate is another drawback.

Radcliffe Chemical Works,
March 2, 1872.

NOTES ON THE

PRESENCE IN CERTAIN FIBRES OF A SUBSTANCE SUSCEPTIBLE OF SOME STRIKING COLORIFIC CHANGES WHEN CHEMICALLY TREATED.*

By WILLIAM SKEY,
Government Analyst, New Zealand.

In attempting to bleach some samples of fibre of *Phormium tenax* with chlorine, I experienced such difficulty that I was led to investigate into the cause, when certain reactions manifested themselves which I think proper to communicate at once, as they show that there exists in certain fibres a substance which, as far as I can learn, has not yet been described in chemical works, and from the deportment of which, with certain reagents, we are able easily to discriminate those fibres which contain it from those in which it is not present.

The results arrived at up to the present time are as follows:—

(1). That a number of fibres (that of *Phormium tenax* included), when allowed contact with chlorine, hypochlorous, or chromic acid, acquire a pale yellow colour, which is changed to a beautiful rose-red, when the fibres are afterwards treated with alkalies, alkaline carbonates, or earthy carbonates; while acids restore the yellow tint when applied to the reddened fibres.

(2). That the alkaline manganates affect these fibres in the same manner as chlorine, &c., except that they are blackened by a deposit of oxide of manganese, which, when removed by the proper acids, leaves the fibre of a yellow colour, subject to the same colouration by contact with alkalies as in the above experiment (No. 1).

(3). That these fibres are coloured a pale yellow by alkalies and their carbonates, but, in the case of these last, the colour is paler than with the alkalies.

(4). That by cold strong nitric acid they are coloured red-brown, which changes to a yellow tint on contact with alkalies.

(5). That slightly diluted cold sulphuric acid renders these fibres quite yellow; while the concentrated acid blackens them at common temperatures.

(6). That, when treated for a long period with chlorine, hot chromic or nitric acids, these fibres are completely whitened, but deteriorated in strength. The addition of ammonia or sulphuric acid has, then, no colouring effect on them.

(7). That *Phormium tenax* exhibits the same reactions with these several reagents, and in as great a degree when previously digested for two hours in boiling ether, alcohol, or chloroform, or for eighteen hours in boiling water, or when soaked in cold water for eight days.

(8). That *Phormium tenax* fibre cut up into lengths of one-eighth of an inch, and digested for twelve hours in boiling water, exhibits as well marked reactions to chlorine in conjunction with ammonia, or to sulphuric acid, as it did before such treatment.

In the annexed columns, the effects of ammonia on the oxidised fibres of certain plants in relation to these changes of colour are stated:—

Coloured Rose-Pink.	Coloured Brown.	Unaltered.
Phormium tenax.	Wood.	Hemp.
Yucca.	*Manilla*, impure.	Sunn hemp.
Sisal.	,, pure (?).	*Rheea.*
Aloe.		Raw cotton.
		Linum.

A great number of samples of *Phormium tenax* have been experimented with, the results being always similar; among these have been—

(1). Those prepared by machinery only.

(2). Those prepared by a short retting process and machined afterwards.

(3). Those prepared by Maoris—the cleanest I could obtain.

(4). Some prepared by myself and which had never been dry, and some of them which had been steeped in water five days.

In respect to the flax (*Linum*) used, it had no appearance of being bleached, but only retted, and I am anxious to learn whether the fresh fibre of this plant would behave to these tests the same as that of the *Phormium tenax*.

This, together with a great many other points, will require time to enable me to determine. It would be desirable, for instance, to know if long-continued retting would remove or change the principle on which the colouration of the fibre depends, and also the effect of sunlight; also, whether the principle is as abundant in the fibre at one season of the year as at another, and if it is equally dispersed through the several varieties and parts of the leaf.

It is premature as yet to enter fully upon the deductions which these results would lead to, but I think the following points are clearly established:—

(1). That certain fibres, among which is *Phormium tenax*, contain a substance quite distinct from the fibre, though such fibres have been prepared with the greatest care, and appear to be quite pure.

(2). That this substance is insoluble in hot or cold water, also in alcohol, ether, and chloroform, and in aqueous solution of hydrochloric acid.

(3). That a small portion of it is on the outside of the fibre, as shown by the carbonate of lime test.

(4). That the whole of this substance is probably in chemical combination with the fibre.

(5). That it cannot be removed chemically without injuring the fibre, as even pure fibre (cellulose), which does not contain this principle, is weakened considerably when passed through these processes.

In reference to the nature of this principle it is difficult to conjecture, as it clings so persistently to the fibre as to appear inseparable, except in an altered state.

From the blackening of the fibres containing it by sulphuric acid, I infer that it is non-nitrogenous—probably it is allied to some of the colouring principles of madder.

When oxidised by chlorine, &c., it has the colour of fresh turmeric paper, which paper is, like this, reddened by contact with alkalies.

In conclusion, I may observe that this substance is not unlikely to be the basis of the yellow and red colour of the *Phormium tenax* and other plants, and that while it may not be necessary to remove it from these fibres for many purposes to which they may be applied, it is questionable whether we can have them of a pure unalterable white colour without its removal.

FURTHER NOTES.

(1). The fresh fibre digested for twenty-four hours in a weak solution of caustic potash, is whitened in those portions of it which have freest access to the liquid, that is, the ends and outside portions; and such portions do not then give any reaction with ammonia after contact with oxidising agents.

(2). That prolonged contact with cold hypochlorous acid also renders such parts colourless, or nearly so, and that ammonia has then no effect upon such fibres.

(3). That, by stopping the second process when the

* Read before the Wellington Philosophical Society, August 26th, 1871.

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fibre is thus divested of the principle giving the reactions before described, such fibre does not appear to be greatly weakened, whether it is tested dry or wet.

(4). That, in the case of the first experiment, the fibre is more weakened than in the second, but still not so much that the fibre appears very easily or readily detached into ultimate ones.

Deductions.

Taking all these results into consideration, I do not see that they tend as a whole to establish any theory which may be brought forward that regards the principle thus indicated as a cement.

It is certainly a very definite principle; but the functions it may or does perform in the growing plant we have yet to learn.

I may state that I have not found it with certainty away from the fibres, while it seems a constant associate of them in their natural, or at least in their green, state.

ACTION OF ALKALIES ON THE FIBRE.

Portions of different kinds of *Phormium* fibre, and also of Manilla hemp, were submitted to the action of a strong solution of caustic potash, and kept at the boiling-point for four hours.

The result was in every case the same, as has been described by Captain Hutton, the fibre being reduced to a soft pulp, like the "half-stuff" of paper manufacturers, in which the ultimate fibres are perfectly non-coherent so long as the mass remains wet, but when dried possessing a considerable amount of tenacity. This is rendered very obvious by the behaviour of an untwisted thread of the fibre thus prepared, which will bear a strain of several pounds when dry, but immediately on touching any portion of it with a drop of water will not bear as many grains.

This experiment was varied in several ways, care being taken to remove the last trace of the alkali from the fibre by treatment with dilute acid and subsequent washing, which had the effect of making the fibre extremely soft, silky, and white, but without in the least depriving it of the above singular property. Alcohol, ether, oil, and other non-hydrating fluids were substituted for the water, but were found not to reduce the cohesion of the ultimate fibres. When examined under the microscope in the dry state, the prepared fibre is found to consist of shrivelled and collapsed ultimate fibres, twisted and matted together; but, on the addition of water, they are easily observed to become distended and separated from one another, acquiring, at the same time, a well-defined smooth outline. The form of the ultimate fibre itself is not much affected, nor does it appear to be in any degree weakened by the action of the potash, as broken cells are rarely seen, even when the dry fibre is parted with some violence; while in the wet state the ultimate fibres can be separated for examination with great facility.

The action of the alkali, therefore, appears to be that of altering, and probably thinning the cell wall, so as to render it capable of absorbing water with rapidity. The fact that the *Phormium* fibre can be reduced by a single process to the "half-stuff" of the paper-maker, but having the very unusual property of being composed of complete fibre cells, having an equal length of about half an inch, and at the same time possessing a pure colour and glossy lustre, may perhaps lead to the introduction of a totally new class of manufactures, by which a material will be obtained with even greater facility than ordinary paper of fine quality, and at the same time possessing an even texture, cohesive strength, and "body."

After the proper form is given to the fibre, by taking advantage of its gelatinous condition when wet, there would be no difficulty in drying it in contact with such a material as would prevent the fibres again absorbing water.

ACTION OF ACIDS.

When a mineral acid was substituted for the alkaline solutions, in experiments similar to the preceding, the fibre exhibited a totally different result, becoming feeble, harsh, and under the microscope showing that the fibre cells were weakened, as, whether broken wet or dry, the ultimate fibres themselves invariably snapped across and presented broken ends. The effect of the application of chlorine, as in the ordinary bleaching process, was the same as that of the acids, but to a less degree.

NOTES OF

DEMONSTRATIONS ON PHYSIOLOGICAL CHEMISTRY AT ST. GEORGE'S HOSPITAL.

By S. W. MOORE.

XIV.

THE spectroscope is one of the happiest discoveries of modern science. It has enabled the chemist to differentiate apparently identical bodies in the organic world, and has also opened to him the knowledge of the constituent elements of many of the heavenly bodies. In the animal world its application is without parallel, so great are the advantages accruing from its use.

It will be necessary to mention, before proceeding to the instrument itself, a few facts concerning light and its properties.

Light is considered to be some disturbing influence acting upon an all-pervading ether, and producing undulations or waves which convey the sensation called light to our retinæ; these waves are not progressive, but may be compared to the motion of a field of standing corn when agitated by a breeze. The known sources of light are the sun, stars, combustion, electricity, and phosphorescence. When vibrations of this ether are capable of being produced in a body, it is said to be transparent; when not so, it is opaque. Opaque bodies either absorb or reflect light. Polished metallic surfaces reflect about 95 per cent of light received; the only instances of total reflection being the third face of a prism and the under surface of a transparent liquid when viewed at the so-called critical angle.

Light undergoes several modifications in passing through transparent bodies, the principal being refraction. In passing from a rare to a dense medium it is refracted, or bent towards the perpendicular; when passing from a dense to a rare medium, the reverse. If a ray of light passes through a transparent body in the form of a prism, not only is the ray bent, but it is dispersed, that is, spread out like a fan, and the band no longer remains white, but consists of red, orange, yellow, green, blue, indigo, and violet, the violet being bent aside the most. This spectrum proves the compound nature of light; if these coloured rays be caught on a lens they become condensed to white light at the focus. If differently coloured glasses be separately interposed between the spectrum and screen, all light will be cut off excepting the rays identical in colour with the glass.

There are three kinds of spectra—the continuous, as developed from the lime-light; the interrupted, when only certain bright lines appear; and the reversed, when in the continuous spectrum black lines are to be seen. This last is typified by the sun. The existence of black lines was discovered by Wollaston; but Fraünhofer, after whom they are named, was the first to map them out.

We saw that certain rays were always visible in one place; thus, if we take a flame incapable of producing a spectrum (a Bunsen), and burn in it some metal, as sodium, which will produce a light, we shall have, not a perfect spectrum, but an interrupted one—that is, bright lines will appear, in this case a yellow one, at definite positions in the field. Each metal having different lines, we are enabled to distinguish them very readily one from another.

The reversed spectrum is produced by the stronger light of the continuous spectrum absorbing the weaker rays of the burning metal or gas; by comparing Fraünhofer's

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lines with the bright lines produced by incandescent bodies we are enabled to tell the constituents of the sun's atmosphere.

Various bodies have the property of stopping the rays of light, and in this way producing black spaces or bands at different parts of the spectrum; these are called absorption bands.

Blood, chlorophyll, anilines, &c., give decisive spectra, readily recognised again.

Inasmuch as the ordinary spectrum contains heat rays in the red portion, light rays in the yellow, and actinic, or chemical rays, in the blue, so at the extreme violet another kind of ray may be developed by introducing a body, like quinine, capable of fluorescing. This is a complicated phenomenon to us at present, but very little understood; it still has been made very available, and has been partially worked out by Stokes and subsequently by Thudichum.

A very useful, but rough, spectroscope may be made by placing an ordinary bisulphide of carbon prism in a dark box, with a slit in one side to receive the light, and a hole in the other through which to observe the spectrum.

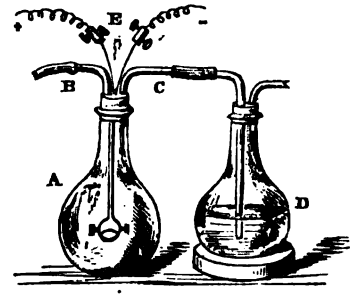
The better instruments are of brass, with condensed glass or quartz prisms and lenses to concentrate the light and magnify the spectrum; by means of a reflecting prism a second spectrum may be thrown on the field.

ON A METHOD OF DEMONSTRATING THE COMBUSTIBILITY OF DIAMOND AND GRAPHITE.

By C. J. WOODWARD, B.Sc.

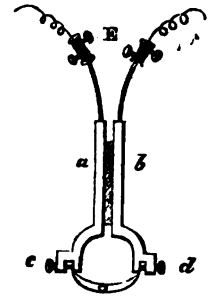
To show to a class the combustion of a diamond in oxygen is an experiment of great interest and importance, but which to exhibit satisfactorily is a matter of some difficulty, at any rate where a small diamond only is used. The usual method, by heating the diamond in a platinum spoon before the blowpipe and then plunging it into oxygen, requires several heatings, and it is seldom the intense light produced by the combustion is seen for more than a second or two, owing to the cooling action of the metal by conduction, which lowers the temperature of the diamond below its ignition-point. The ingenious arrangement of Faraday's, in which the diamond is placed in a platinum spoon over a jet of burning hydrogen, and the whole lowered into a vessel of oxygen, serves very well; but if the platinum spoon be thin it is liable to be melted, and if thick it cools the diamond too much after the hydrogen is turned off. I have used a cup of pumice-stone placed in a deflagrating spoon for supporting the diamond, and with considerable success; but a recent failure induced me to contrive an arrangement which answers very well indeed. The method will be understood by reference to the accompanying woodcut (Fig. 1). A flask, A, of about a litre capacity is fitted with a caoutchouc stopper. Through the centre of this stopper passes the little arrangement shown in Fig. 2, in which *a b* are two strips of brass insulated from each other by a strip of bone. Each of the lower ends of *a b* terminates in a clamp, *c d*, while the upper ends which project through the stopper are connected with binding screws, E, for attaching to a battery. Between the clamps, *c d*, is stretched a thin strip of platinum foil hollowed in the centre to form a cup to receive the diamond. Besides this arrangement passing through the centre of the stopper, there are also two tubes, B and C; B is connected with a supply of oxygen, and C is connected with the flask D, fitted up like a wash-bottle. To use the apparatus, the diamond is placed in the platinum cup, and the stopper, with its fittings, placed in A. The tube, B, is connected with a bag of oxygen, and C attached to the long tube of the wash-bottle, D, which is half filled with lime-water. The oxygen is allowed to bubble through the lime-water for a few seconds, to show that it will not produce a turbidity. The binding screws, E, are then connected with a sufficiently powerful voltaic battery, when the platinum cup becomes heated and soon the diamond

FIG. 1.



starts into combustion. The carbonic anhydride formed passes into D, and soon reveals its presence by producing a milkiness in the lime-water. Should it be desired to show the combustion of graphite, a little of the powdered

FIG. 2.



mineral is put in the spoon and kept heated by the battery, when in a very short time sufficient carbonic anhydride will be formed to produce a reaction by the lime-water.

Midland Institute, Birmingham,
February 19, 1872.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 7th, 1872.

Dr. DEBUS, F.R.S., Vice-President, in the Chair.

AFTER the minutes of the previous meeting had been read, Messrs. George T. Atkinson, William Foster, and Benjamin P. Medcalf were formally admitted as Fellows of the Society.

The list of donations having been read, the proposed changes in the Officers and Council for the ensuing year was announced from the chair.

The names of the gentlemen whose certificates were read for the first time were Messrs. William Frederick Donkin, B.A., Charles D. Hunter, Reynold Le Neve Foster, Alexander Noble, W. Little, and William Henry Walbourn. For the third time—Henry Baden Pritchard, James Ballantyne Hannay, J. Vincent Taylor, George Smithers Packer, Robert William Atkinson, and Walter William Fisher, B.A., who were then balloted for and duly elected.

Dr. DEBUS, having left the chair, which was taken by Professor Williamson, read a paper "*On the Reduction of Ethylic Oxalate by Sodium Amalgam.*" The author

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pointed out that, by the oxidation of alcohol, C_2H_5,HO, a series of more highly oxidised compounds was formed —viz., glycol, C_2H_4,HO,HO, containing two of hydroxyl, which then yielded successively glycollic acid, $C_2H_4O_3$, glyoxylic acid, $C_2H_2O_3$, and ultimately oxalic acid, $C_2H_2O_4$. One would naturally conclude that if we reversed the process and treated oxalic acid with reducing agents, we should obtain the same series of compounds, but in an inverse order. From these considerations, he was induced to repeat the experiments of Friedlander, who, about the year 1864, by the action of sodium amalgam on ethylic oxalate in the presence of alcohol, had obtained the sodium salt of a new monobasic acid, which he named glycolinic acid, $C_2H_4O_4$. The author, in the first instance, carefully followed the process described by Friedlander. Sodium amalgam was added to ethylic oxalate, mixed with three times its weight of absolute alcohol, until heat ceased to be evolved and the mixture became pasty, taking care, however, to keep the mixture cool; it was found that for this purpose about one molecule of sodium was required for each molecule of ethylic oxalate. On adding a considerable quantity of ether and a little water to the product, it separated into two layers, the lower being pasty, from the sodium salts of the acids formed during the reaction. Lead acetate precipitated a portion of these acids, which, on examination, and by analysis of the calcium salt, was found to be *tartaric acid*. In the portion not precipitated by lead acetate, the sodium salts were converted into calcium salts, and separated by fractional crystallisation into nine portions, all of which, on analysis and from their physical properties, were found to be pure calcium glycollate. The mother-liquors also, with the exception of a minute quantity of the salt of an uncrystallisable acid, contained nothing but glycollate, the author being unable to detect any trace of a compound corresponding to Friedlander's glycolinic acid. An experiment was also made employing considerably less sodium amalgam, but with the same result, nothing but glycolic and tartaric acids being found. The author had also in his possession a few centigrammes of the sodium glycolinate prepared by Friedlander, the crystalline form of which appeared to be identical wtth that of sodium glycollate.

Dr. Williamson said that no doubt the Fellows had listened with great pleasure to the author's account of the series of accurate experiments he had made on the action of sodium amalgam on ethylic oxalate; but he would like to ask him whether in this reaction glyoxylic acid was not first formed, which then split up into glycolic and oxalic acids? The theoretical question as to whether the hydroxyl ever exceeded in number the carbon atoms present in organic compounds was one of great importance. From a theoretical point of view, certainly, an aqueous solution of carbonic acid might be regarded as CO,HO,HO, there being two of hydroxyl to one of carbon; but it was a remarkable confirmation of the view held by Dr. Debus, that no compound having the composition just mentioned had ever been isolated. Even the hydrate of SO_2 was very unstable.

Dr. Debus replied that in the second experiment, where the reaction had been stopped before the mixture became alkaline, he had not searched for glyoxylic acid. In the experiment where excess of sodium amalgam had been employed of course it would be useless, as the alkali present would have decomposed the glyoxylic acid if it had previously existed.

Dr. Wright remarked that, in the case of chloral hydrate, there would appear to be two of hydroxyl united to one of carbon, as it was a compound quite analogous to chloral alcoholate. Now the latter, by the action of phosphorus oxychloride, did not yield ethylic chloride, as it would undoubtedly do if its formula were—

$$\left.\begin{matrix}COH\\CCl_3\end{matrix}\right\} + \left.\begin{matrix}H\\Et\end{matrix}\right\} O,$$

so that its composition would be represented by—

$$\begin{matrix}CH(OH)(OEt)\\CCl_3\end{matrix}$$

and the analogous chloral hydrate would then be—

$$\begin{matrix}CH(OH)_2\\CCl_3\end{matrix}$$

Dr. Debus replied that, even if it were established that chloral alcoholate had the formula he gave, it would not apply to the remark he had made, which referred only to hydroxyl; he had never affirmed it of a carbon group like ethoxyl. The chloral hydrate he regarded in the same light as any other hydrate.

A paper "*On Metastannic Acid and the Detection and Estimation of Tin*," was then read by the author, Mr. A. H. Allen, F.C.S. Having found considerable discrepancy between the various text-books as to the solubility of metastannic acid in acids, he was induced to examine the subject, and finds that the acid which was prepared by the action of nitric acid on metallic tin is soluble to a large extent in concentrated hydrochloric acid. Metastannic acid is completely soluble in concentrated sulphuric acid, and the addition of water to this solution causes the precipitation of ordinary stannic hydrate, and not metastannic acid, as is generally stated; so that the action of sulphuric acid on metastannic acid converts it into ordinary stannic sulphate, $Sn''''(SO_4)_2$, which is decomposed by water, stannic hydrate, SnH_2O_3, being precipitated; but when the liquid is boiled, metastannic acid is formed, and the precipitation of the tin becomes complete. This conversion into stannic sulphate makes the reaction valuable for analytical purposes, the addition of strong hydrochloric acid rendering the solution capable of being largely diluted without any precipitation taking place, so that by the addition of tartaric acid, ammonia, and a magnesium salt, phoshoric and arsenic acids can be readily detected. The author then described several other analytical processes in which this reaction is available, and concludes his paper with some remarks on the action of nitric acid on alloys containing tin and gold, and on the composition of "purple of Cassius," which may be regarded as containing aurous and stannous stannate, $(Au'_2SnO_3,Sn''SnO_3+4aq)$.

The Secretary then read a "*Note on the Quantity of Cæsium contained in the Water of the Hot Springs found in Wheal Clifford*," by Colonel Philip Yorke, F.R.S. The temperature of the spring is 125° F., and an analysis of the water made by Dr. Allen Miller in 1864 showed it to contain 646 grs. of saline matter per gallon, of which 26 grs. were lithium chloride. He also stated that it contained potassium chloride and a little cæsium chloride. The author has since had some of the water concentrated by evaporation, and ascertained the amount of cæsium present in it, from which it would appear that 1,000,000 parts of the original water contain about 1·7 parts of cæsium chloride. The Dürkheim water, according to Bunsen, contains only 0·17 parts, so that the "Wheal Clifford" spring is at least ten times as rich in cæsium as the Dürkheim water.

The meeting then adjourned until Thursday, March 21, 1872.

NOTICES OF BOOKS.

Chemical Notes for the Lecture-Room: On Heat, Laws of Chemical Combination, and Chemistry of the Non-Metallic Elements. By Thomas Wood, Ph.D., F.C.S., Chemical Lecturer at the Brighton and Lancing Colleges, Author of "Notes on Metals," &c. Third edition. London: Longmans, Green, and Co. 1871.

This is essentially a school work, and, in accordance with its character, Dr. Wood confines himself to the elementary principles of the science. He says: "I take this opportunity of advising beginners who wish to study chemistry not to commence by reading a book on the subject, but attend first a course of some eight or ten elementary lectures on, say, the components of the atmosphere, thus acquainting themselves with the apparatus, names, modes

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of thought and expression common to the science." Most cordially do we endorse his advice, while we think that there are few better note-books that could be appended to such a course of lectures than Dr. Wood's.

The Retrospect of Medicine: being a half-yearly journal containing a retrospective view of every discovery and practical improvement in the Medical Sciences. Edited by W. BRAITHWAITE, M.D., and JAMES BRAITHWAITE, M.D. Lond. Vol. lxiv., July—December, 1871. London: Simpkin, Marshall, and Co.

ANOTHER volume has been added to this useful record. It embraces a full description of many new medical instruments, and a report of the lectures delivered during the last half year at which any instance of the advancement of medical science occurred. Perhaps the most interesting paper to chemists is that by Dr. Benjamin Ward Richardson, F.R.S., who chronicles his experiences with amyl hydride, or, as he abreviates it, *hydramyl*. Hydride of amyl Dr. Richardson finds to be a solvent of many medicinal substances—among them are iodine (the solution being useful in cases of fœtid ulcerative and suppurative wounds, and in cancer), oils and fats (the solution employed for burns, scalds, &c.). Ammoniated hydride of amyl forms an admirable preservative for pathological preparations. Dr. Richardson places the specimen to be preserved, with half an ounce of the ammoniated solution of the hydride, in a well-stoppered jar. The jar being placed in a cool place, there is not the least occasion to hurry over an examination, for the specimen will keep (even for microscopical research) three or four days in excellent condition.

Dr. Richardson prepares a new anæsthetic agent, which he terms *hydramyl-chlor*, in the following manner:—

"In making bichloride of methylene, we place a mixture of alcohol and chloroform in contact with pure zinc. On the application of heat there is set up a brisk action, during which an equivalent of chlorine from the chloroform ($CHCl_3$) passes to the zinc, and after a free escape of gases bichloride of methylene (CH_2Cl_2) distils over. On one occasion whilst manufacturing some bichloride of methylene, an addition was made to the materials in the retort prepared for making the bichloride of about eight times the volume of amyl hydride. The result was an immediate brisk action without the aid of heat. A copious stream of gases first passed over, and then, the fluid in the receiver having risen in temperature, there began to distil a compound fluid, very light specifically, and of a most agreeable odour. This fluid, when collected, had a specific gravity of 0·699, and it commenced to boil at 92° F. It was much more agreeable for inhalation than the simple hydride, was stable, and acted excellently as an anæsthetic. After carefully testing the vapours of this compound, it was administered fourteen times in cases of extraction of teeth, with results almost identical with those that followed the administration of simple hydramyl. In repeating the process of distillation, the first portion that distilled over was set aside, and none was collected until the temperature had reached 90°, the temperature being sustained between that degree and the degree of temperature of the human body (98°). By this means there was obtained a fluid still very agreeable to breathe and extremely rapid in its action. This fluid has the specific gravity of rectified ether—viz., 0·725. It boils in the warm hand, and may be considered as containing one part of bichloride of methylene in nine of amyl hydride. I propose to call this fluid 'hydramyl-chlor.'"

From many miscellaneous remarks we select those of Dr. John Day on colour tests for blood:—

"Prepare some fresh tincture of guaiacum by putting a few pieces of pure unoxidised guaiacum resin into a small bottle and filling it with alcohol—after shaking a minute or two it is fit for use. The stain must be moistened with this, and if this is followed by a negative result (many substances would produce a blue colour) we must add a few drops of antozonised ether, when, if blood be present, oxidation and bluing of the guaiacum will follow. Robbins's ozonic ether is the best for this purpose. Blood produces no change in the colour of guaiacum, except in the presence of antozone. A liquid has become antozonised when it is changed by absorption of oxygen from the air. All essential oils take on this change rapidly, and they then acquire the property of combining in all proportions with alcohol, and a little essential oil diluted with alcohol will do very well instead of the ozonised ether. By variations of this test, mucus, saliva, and pus may be detected. It appears probable that this test will prove of service in medical cases—in testing for blood in matters vomited or expectorated."

CORRESPONDENCE.

REMARKABLE ELECTRICAL PHENOMENON.

To the Editor of the Chemical News.

SIR,—In carrying out a series of experiments for the purpose of making uninsulated, or imperfectly insulated wires, available for telegraphy, I have met with a remarkable phenomenon which I do not know has been before observed.

By the kind permission of the owners, I submerged a mile or two of naked wire in Wimbledon Lake for experimental purposes, and I found that, on charging it with electricity of either name, it retained the charge obstinately for many minutes. For instance, after attempting to discharge it, at intervals of five seconds, for three minutes, I found it still retained a very considerable portion of the charge, so that I have no doubt it would still have retained some portion after five or six minutes.

This may be due partly to polarisation (so called) of the wires, but I can scarcely think that this would continue for so long a time. I am inclined myself to attribute it to the electrisation of the strata of water surrounding the wire, which, like the glass in a Leyden phial, require a considerable time to lose their polarity entirely. In salt water I find that the phenomenon almost disappears.—I am, &c.,

H. HIGHTON.

2, The Cedars, Putney,
March 11, 1872.

WATER ANALYSIS.

To the Editor of the Chemical News.

SIR,—In August last I recorded my failure with Messrs. Wanklyn and Chapman's ammonia process for the estimation of organic matter in water. I persevered, however, in my attempts to work a process promising such useful results, and I now write to record my success. I have no hesitation in acknowledging my error, as the failure was entirely caused by misplaced confidence in the government apparatus supplied me. The apparatus was of very inefficient appearance; but, as I failed to find details on the apparatus required in Messrs. Wanklyn and Chapman's treatise, I committed the error of taking upon trust the assurances made me that the apparatus was all correct. Anyone acquainted with the deplorable state of chemistry in India can imagine the embarrassment of an analyst in an up-country station totally unprovided with the means of remedying the apparent defects in an apparatus supplied for working a process of a novel description. I will only say that I got out materials of my own, and have been able to construct apparatus that worked successfully.

The process gives good results, apart from the inherent error of the colorimetrical estimation. They agree very fairly with those obtained by the permanganate process (when this is practicable, which is not always the case),

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and usually confirm the more important deductions obtainable from mineral analysis. Further experience is, however, required before I can speak positively as to the interpretation to be placed on the results of the process. There are peculiarities about Indian waters which render considerable study of them necessary, both from a chemical and hygienic point of view; and their type differs so much from that of British waters, that the greatest mistakes may be made if hygienic opinions be given on them according to the rules accepted at home. For instance, a well water is found to contain nitric acid in such quantity that its quality would be expressed in England by many thousand parts of sewage contamination; yet it is in reality nearly as pure as rain water. I have seen such waters containing much more nitric acid than chlorine, and free from any earthy salts whatever. *Per contra*, I have met with waters obviously contaminated with sewage, yet absolutely free from nitric acid, and containing organic matter not differing from that of pure water. These peculiarities render a good mineral analysis of absolute necessity; for nitric acid may appear in a water free from any suspicion of sewage contamination; nitrogenised organic matters may oxidise into nitric acid, this again may disappear on exposure to atmospheric influences, and each of these points is open to curious exceptions; but the evidence of the mineral constituents never fails, and I regard their accurate determination as of primary importance.

The necessity of modifying both the practice of hygienic analysis and the opinions deduced from it, in the case of Indian waters, is well shown by the results of the Bengal system of water analysis. For four years the waters of the military stations of Bengal were examined on a method drawn up in neglect of the peculiarities of Indian waters. The consequence was that the results, obtained at an enormous expense, were in the greater number of cases most erroneous, and, from a chemical point of view, worthless. Fortunately, the errors were so gross and obvious that no chemist could be deceived by them; still the investigations have turned out an utter blank, and will have to be gone over again before long.—I am, &c.,

Edward Nicholson, Assist. Surg. R.A.,
Analyst of Waters, Mysore, Northern, and Ceded Districts.

Bellary, February 17, 1872.

MISCELLANEOUS.

The Proposed Memorial to Dr. Priestley.—We hail with satisfaction the proposal of Birmingham to erect a statue of Dr. Priestley. There are but few memorials of scientific men in the country, and at present, excepting a Bath-stone statue in the Museum at Oxford, no public recognition of the great services of Priestley exists. The proposal, though originating in Birmingham, is receiving support from scientific men all over the kingdom, and even beyond; the subscription list including Sir Benjamin C. Brodie, Bart.; Professor Huxley; Dr. Frankland; Sir Rowland Hill, K.C.B.; Dr. W. J. Russell; Professor Michael Foster; Professor Vernon Harcourt; Dr. Herman Kolbe, Liepzig; H. Christian Meyer, Hamburg; and others.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, February 26, 1872.

This number contains the following original papers and memoirs relating more especially to chemistry:—

Invention of the Method of Wine-Preserving by the Application of Heat.—Dr. Balard.—The contents of this lengthy essay are not of general interest, bearing mainly upon a question of priority of invention. A reply to this paper is also published under the following title:—

Reply to Dr. Balard's Paper on the Priority of Invention of the Method of Wine-Preserving by the Application of Heat.—Dr. Thenard.

Application of Secondary Electric Currents for the Purpose of Accumulating or Transforming the Effects of the Galvanic Element.—G. Planté.

Electromotive Force Developed by the Contact of Metals and Inactive Liquids.—J. M. Gaugain.

Two New Isomeric Bromides of Propylen.—E. Reboul.—The author first refers to some of his former researches on the monobromated ethylen and propylen, an account of which was published in the above-named periodical more than two years ago, and next records at great length how, while preparing bromide of allyl by Tollens's method, he accidentally obtained a large quantity of a new bromide of propylen isomeric with the other bromide of that base already known, and distinguished from it (the sp. gr. = 1·93 at 19° being the same) by a different boiling-point (which is some 20° higher) and also by its peculiar behaviour with alcoholic potassa solution at a high temperature (100°) and in sealed tube, the result of this reaction being that first a molecule of bromhydric acid is removed, and thereby the bromide of allyl regenerated, and this becoming further decomposed produces allyl-ethylic ether; when water is added to the distillate of the aforesaid fluid, the water separates a lighter liquid exhibiting the odour of allyl-ethylic ether, which on being re-distilled yields that ether, but contaminated with a small quantity of bromated propylen. The mode of formation and of dissociation of the compound alluded to, $C_3H_6Br_2$, justify it being called bromhydrate of bromide of allyl. Another compound, also isomeric with the bromide of propylen, is obtained by the direct union in the cold of bromhydric acid with allylen, whereby two liquids are formed—one of them, boiling at 114°, is the dibromhydrate of allylen—

$$C_3H_4\begin{cases}HBr\\HBr\end{cases};$$

the second is monobromhydrate, $C_3H_4.HBr$, boiling at 48°, and isomeric with the bromated propylen.

Iodide of Starch.—J. Personne.—This short note simply contains a rectification in reference to an opinion published by E. Duclaux to the effect that the iodide of starch is not a genuine chemical compound but rather a physical mixture, that is to say, that the iodine and starch stand to each other in the same relation as the colouring-matter of lakes to the inorganic materials which form the great bulk thereof. The author's object is chiefly to point out that what was recently put forth by E. Duclaux on this subject, was done so six years ago in precisely the same manner by him.

This number contains also some very important memoirs on meteorology, astronomy, and physiology.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 3, 1872.

This number contains the following original papers and memoirs:—

Experiment for Synthetical Preparation of Parabanic Acid.—B. Tollens.—After first referring to the researches of Henry, Emmerling, Jacobson, and Maly on the derivatives of thiosinnamine, the author states that he has saturated an aqueous solution of urea with cyanogen gas, but at the ordinary temperature no reaction takes place even after the fluid has been standing for some days. When, akin to what takes place with thiosinnamine when treated with cyanogen, urea combines with the latter body, and the dicyamine resulting therefrom is converted into the corresponding oxalyl-urea, parabanic acid must be obtained. The author continues his researches on this subject.

Mono-Allyline and Glycerin-Ether.—B. Tollens.—Reference is first made to the substance which Linnemann and Zotta (*Ann. d. Chem. u. Pharm.*, suppl. viii., p. 254) and von Gegerfelt have described under the name of glycerin-ether, which these *savants* state to be identical with the mono-allyline prepared by the author and described in *Ann. d. Chem. u. Pharm.*, vol. clvi., p. 149, notwithstanding that the glycerin-ether exhibits quite different properties, composition, and products of decomposition. For the purpose of more minute investigation, the author has repeated his former researches on mono-allyline, and has also prepared glycerin-ether. The former substance is a thickish liquid, boiling at from 225° to 240°; formula, $C_6H_{12}O_3$; one of the products of decomposition by heat of mono-allyline is allyl alcohol. Glycerin-ether is a colourless fluid, which is miscible with water in every proportion (according to Linnemann and Zotta, 1 part of glycerin-ether requires 20 parts of water for solution); when boiled with dilute sulphuric acid, this ether is at first hardly acted upon at all, but when the fluid becomes more concentrated it becomes yellow-coloured, while very irritating vapours are given off, which reduces ammoniacal silver solution. This exhaustive essay further contains a detailed account of the behaviour of mono-allyline and glycerin-ether with various reagents; mono-allyline and glycerin-ether are not identical substances, but there may exist (which is the subject of further researches) a genetic relation between these two bodies.

Bibrom-Propionic Acid.—G. Munder and B. Tollens.—When allyl-alcohol bromide, boiling at from 210° to 214°, is treated at a gentle heat with nitric acid (sp. gr. at from 1·4 to 1·48), the result is the formation of bibrom-propionic acid, which, when purified, is a

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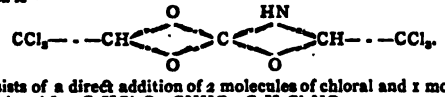
crystalline body, $C_3H_4Br_2O_2$, fusing at 64° to 64·5°, boiling with partial decomposition at between 220° and 240°, and readily soluble in water and ether. The authors describe at length a series of experiments, mainly made with the view to ascertain whether this acid is identical with a bibrom-propionic acid described by Friedel (*Ann. d. Chem. u. Pharm.*, suppl. iii., p. 72); as far as the experiments have been concluded, the authors of this paper state that the acid they have obtained is identical with that just mentioned, and the constitutional formula of both is $CH_2Br-\cdot\cdot-CHBr-\cdot\cdot-COOH$.

Observations on the Analysis of the Milk of Women.—A. Schukoffsky.—In the introduction to this paper the author reviews the more recently described methods of analysis of the milk yielded by women, and points out the defects of these methods, after which a detailed description is given of a process of analysis (estimation of casein, butter, milk-sugar, saline matter, and water) of the fluid alluded to by its peculiar behaviour with ether and very strong alcohol. To from 20 to 25 c.c. of milk, an equal bulk (18 to 20 grms. by weight) of ether is added, and, next, from 30 to 35 c.c. of very strong alcohol (90 to 96 per cent) are added, whereby the casein is separated (coagulated), and after some twenty-four hours the milk-sugar is also thrown down, and can be collected on a filter along with the casein; these substances are washed with very strong alcohol and anhydrous ether; the latter fluid is next separated by distillation on a water-bath, and the remaining alcohol, carefully evaporated, leaves the butter contained in the milk.

Amblygonite from Montebras.—Dr. C. Rammelsberg.—The contents of this essay point out the errors of Moissenet's analysis of the mineral already mentioned in our pages (see vol. xxv., p. 45). The eminent German mineralogist just named states that he has very minutely investigated the Montebrasite, and finds it to be amblygonite, and to consist, in 100 parts, of—Phosphoric acid, 48·55; alumina, 36·36; lithia, 7·96; soda, 0·93; potassa, 0·40; fluorine, 10·06; total, 104·36. The mineral alluded to is identical with the amblygonite found at or near Penig, in Germany.

Action of Chlorine and Bromine upon an Alcoholic Solution of Hydrocyanic Acid.—C. Bischoff.—Notwithstanding the very high scientific value of the contents of this monograph, it is not suited for useful abstraction.

Contribution to the History of Chloral.—C. Bischoff.—This paper treats on the action of the vapour of cyanic acid upon chloral, which, when carefully conducted, results in the formation of a new body, $C_3H_3Cl_6NO_3$, a solid substance, fusing at from 167° to 170°, and yielding, when boiled with caustic potassa solution, chloroform, formic and carbonic acids, and ammonia, that is to say, the products of dissociation of chloral and cyanic acid. The new body's constitutional formula is—



It consists of a direct addition of 2 molecules of chloral and 1 molecule of cyanic acid—$2C_2HCl_3O + CNHO = C_3H_3Cl_6NO_3$.

Derivatives of Fulminic Acid.—E. Sell and R. Biedermann.—This paper treats chiefly on the action of iodine upon fulminate of mercury, whereby an organic compound, $C(CN)(NO_2)I_2$, is obtained, corresponding to the substance obtained by Kekulé by the action of bromine upon the fulminate just named. The iodine-containing body just alluded to is a crystalline substance, fusing at 70°, and decomposed at 170°, evolving vapours of iodine; treated with caustic alkaline solutions at a higher temperature, ammonia is given off; with nitric acid, hardly any reaction takes place; while concentrated sulphuric acid sets iodine free; the final product of the reduction of this body with tin and hydrochloric acid is methylamine. The authors observe, as regards the action of the three haloids—chlorine, bromine, and iodine—upon fulminate of mercury, that chlorine eliminates the mercury as well as the cyanogen group; bromine leaves a portion of the cyanogen group in the shape of bibromo-nitro-aceto-nitrile; while iodine does not act upon the cyanogen group at all; the following formulæ exhibit these reactions:—

Cl.	Br.	I.
$C(NO_2)Cl_2$	$C(NO_2)Br_2$ $C(NO_2)(CN)Br_2$	$C(NO_2)(CN)I_2$

Isocyanate and Isocyanurate of Benzyl.—E. Letts.—In the introduction to this valuable essay the author refers at considerable length to the researches of Drs. Wurtz, Cloëz, A. W. Hofmann, Olshausen, and Canizzaro on subjects closely related to his researches. Next, a series of new bodies, their preparation and properties, are minutely described: among these we quote the following:—Benzyl-isocyanate is a colourless fluid, which was not, however, obtained free from benzyl chloride, and did not exhibit a quite fixed boiling-point, but this, notwithstanding the products of conversion and derivatives from this body, made it clear that the compound

$$C_8H_7NO = \left\{\begin{matrix}CO\\C_7H_7\end{matrix}\right\}N = \left\{\begin{matrix}CO\\C_6H_4.CH_2\end{matrix}\right\}N$$

had been obtained. The other bodies described at great length in this exhaustive essay are—Monobenzyl-urea; dibenzyl-urea; phenyl-benzyl-urea; and benzyl-isocyanurate, a solid crystalline substance, insoluble in water, difficultly soluble in ether, somewhat more readily soluble in hot alcohol; fusing-point, 157°; boiling-point, above 320°.

Conversion of Oil of Turpentine into Cymol.—A. Oppenheim.—The contents of this lengthy monograph are, notwithstanding the very high scientific merits, not suited for abstraction, an observation also applying to the two following essays, of which we quote the headings of the sections:—

Aromatic Phosphines.—Dr. A. W. Hofmann.—Benzyl-phosphine—

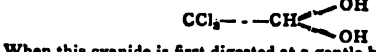
$$C_7H_9P = \left\{\begin{matrix}C_7H_7\\H\\H\end{matrix}\right\}P;$$

dibenzyl-phosphine—

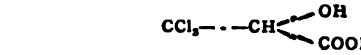
$$C_{14}H_{15}P = \left\{\begin{matrix}C_7H_7\\C_7H_7\\H\end{matrix}\right\}P.$$

Products of the Oxidation of Methyl- and Ethyl-Phosphines.—Dr. A. W. Hofmann.—Monomethyl-phosphinic acid; silver, lead, and barium salts of this acid; dimethyl-phosphinic acid; silver, lead, and barium salts of this acid; ethyl-phosphinic acid; diethyl-phosphinic acid.

Chloral Cyanhydrate and Trichlor-Lactic Acid.—C. Bischof and A. Pinner.—The authors first briefly refer to the researches of Dr. Städeler on the action of hydrocyanic and hydrochloric acids upon chloral (*Ann. d. Chem. u. Pharm.*, vol. cv., p. 293), and then state that they have repeated these researches, causing the acids alluded to to act separately (at least hydrocyanic) as well as jointly on chloral. The result of the action of hydrocyanic acid, aided by heat, upon that body is the formation of a solid crystalline substance, readily soluble in water, alcohol, and ether; very bitter tasted; yielding, by dissociation, chloroform, hydrocyanic and formic acids; and yielding, by elementary analysis, results leading to the formula—



When this cyanide is first digested at a gentle heat with hydrochloric acid, and the resulting fluid next evaporated upon a water-bath, there remains sal-ammoniac, along with a yellowish coloured liquid of the consistency of a syrup, which, on being taken up by ether and evaporated in a vacuum, yields a crystalline body, which (also by the salts it yields) was ascertained to be trichlor-lactic acid—



The authors continue their researches on this subject.

A Third Nitraniline.—J. F. Walker and Th. Zincke.—The authors record in this lengthy essay, which treats on the different nitranilines in general, their researches on a peculiar nitraniline obtained by them from the γ-brom-nitro-benzol of Hübner and Alsberg, and the nitraniline thus obtained has been termed meta-nitraniline, a solid crystalline body. The following tabulated form exhibits a review of the different kinds of nitraniline:—

Ortho series.	Meta series.	Para series.
α-Brom-nitro-benzol, fuses at 125°.	γ-Brom-nitro-benzol, fuses at 37° to 38° (Hübner and Alsberg).	β-Brom-nitro-benzo fuses at 56° (Griess).
α-Brom-aniline (from acetanalide).	γ-Brom-aniline (Hübner and Alsberg).	β-Brom-aniline (Griess).
Nitraniline (from acetanalide), fuses at 146°.	Meta-nitraniline, fuses at 66°.	Para-nitraniline, fuses at 108°
Ortho-nitro-phenol, fuses at 110°.	Nitro-phenol, fuses at 45°.	Unknown binitro-benzol.
Bibrom-benzol, fuses at 89°.		

This number contains the very excellently written biographies of the late Dr. Adolf Strecker, illustrated by a photogram, and of Dr. Carl Julius Fritzsche; the former memoir being from the hand of Dr. R. Wagner, and the latter from Dr. A. Boutlerow. The two deceased men, the first-named a German, the other a Russian *savant* (native of Saxony), were deservedly and widely known in the scientific world.

Jahrbuch der Kaiserlich-Königlichen Geologischen Reichsanstalt, No. 3, 1871.

In addition to a series of essays and papers more especially bearing upon the geology, mineralogy, palæontology, and geognosy of the Austro-Hungarian empire, this number contains the following papers relating to chemistry:—

Fluorescent Amber.—L. Walcher von Moltheim.—A piece of amber about 4 centims. in length was found in 1869 at the mouth of the river Simeto, near Catania (Sicily); the colour of this substance is blue, but honey-yellow when seen against the light, with the exception, however, of the outer crust, which always exhibits the last-named hue; the substance is turbid internally. From the investigation made with the application of differently coloured light, it appears that this piece of amber consists internally of a very strongly-fluorescent mass, and a non-fluorescent outer crust.

Zincspath from Raibl (Carinthia).—Dr. E. Ludwig.—This mineral was found to consist, in 100 parts, of—Carbonic acid, 31·33; silica, 0·27; oxide of zinc, 59·59; oxide of iron, 7·42; water, 1·44; total, 100·04.

Meteorite from Shergotty.—Dr. E. Ludwig.—This stone was found to consist, in 100 parts, of—Silica, 50·21; alumina, 5·90; protoxide of iron, 21·85; magnesia, 10·0; lime, 10·41; soda, 1·28; potassa, 0·57; total, 100·22. In the inaugural dissertation of Dr. Frank Crook ("On the Mineral Constitution of the Ensisheim, Mauerkirchen, Shergotty, and Muddoor Stones;" Göttingen, 1868) the result of the analysis of the Shergotty (British India) meteorite is quoted as follows, percentically:—Nickel-iron, 9·44; chromite, 0·32; silica, 36·21; alumina, 1·87; protoxide of iron, 27·04; magnesia, 24·11; lime, 0·44; soda, 0·22; potassa, 0·11; total, 99·76. Dr. E. Ludwig

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states the following respecting this discrepancy:—A piece of the genuine Shergotty stone was sent direct from Calcutta to Vienna by Dr. T. Oldham, and Dr. F. Crook obtained from Vienna, through the kindness of Dr. F. Wöhler at Göttingen, a few small pieces of the stone alluded to, but it is evident that Dr. Crook has mistaken the sample of another mineral or meteorite for that of the Shergotty, Dr. Ludwig having taken his sample for analysis from the larger one kept in the Mineralogical Museum at Vienna.

Bayerisches Industrie und Gewerbe-Blatt (double number), November and December, 1871.

In addition to the official notices and reports usually met with in this periodical, this number contains the following original paper relating to chemistry and collateral sciences:—

Silvering of Glass.—Dr. Bothe.—This lengthy paper contains several hints and practical receipts for the purpose of silvering glass, from which we quote the following particulars:—Ingredients and apparatus required—Sal-Seignette (tartrate of potassa and soda), solution of that salt in water, 1 grm. to 50 of water; of ammonia liquida, 50 c.c.; solution of nitrate of silver, 1:8; glass flask of 1000 c.c. cubic capacity for the reduction fluid, and a like flask for the silvering fluid. Reduction fluid—Mix with 900 c.c. of pure distilled water, 90 c.c. of the above-mentioned solution of the Seignette salt; pour this liquid into the glass flask, and let it boil violently; while thus boiling add 20 c.c. of the solution of nitrate of silver, and continue the boiling for some ten minutes longer; this fluid, which now contains oxytartrate of oxide of silver, can be kept for any length of time, and improves on keeping; if left in the flask, which for convenience should be labelled (1), the liquid has to be filtered before use through filtering-paper. The silvering fluid is made in the following manner:—Nitrate of silver is first dissolved in distilled water, and next ammonia added until the precipitate at first appearing is again dissolved; the liquid is next filtered, and diluted with so much water that 1 grm. of the silver salt makes 100 c.c. of solution. For the purpose of silvering, equal quantities by bulk of the fluids alluded to are first each separately filtered, and next poured together into a vessel of suitable size and shape wherein the glass plate to be silvered is then placed; this glass should be first scrupulously cleaned.

Bulletin de la Societé d'Encouragement pour l'Industrie Nationale, December, 1871.

This number does not contain any original papers or memoirs relating to chemistry, but, under the heading "Miscellany," it is stated that, to prevent solutions of gum, mucilage, and ordinary ink becoming mouldy, it is only necessary to add a few crystals of sulphate of quinine to those fluids.

Les Mondes, February 22, 1872.

This number does not contain any original papers relating to chemistry.

NOTES AND QUERIES.

Artificial Pumice.—Can any of your readers give me information respecting the nature of artificial pumice referred to in Bunsen's account of his filter-pump?—T. D.

Fractional Distillations.—Would your readers kindly inform me in your next issue whether it is proper, in fractional distillations, to let the bulb of the thermometer be in the liquid or above it?—H. D.

Prussian-Blue and Bichromate of Potash.—Can any of your readers kindly inform me where prussian-blue can be procured in powder soluble in water? I understand it is used largely in America amongst paper makers for colouring and tinting paper, but I am not aware of its being used here except in the form of paste; its commercial value is about 1s. per lb. Also, is bichromate of potash manufactured on the Continent, or is it all manufactured by the two Scotch makers?—IGNORAMUS.

MEETINGS FOR THE WEEK.

MONDAY, March 18th.—Medical, 8.
—— Anthropological, 8.
—— London Institution, 4. Prof. John Ella, "On Elementary Music."
TUESDAY, 19th.—Royal Institution, 3. Dr. W. Rutherford, F.R.S.E., "On the Circulatory and Nervous Systems."
—— Civil Engineers, 8.
—— Zoological, 9.
WEDNESDAY, 20th.—Society of Arts, 8.
—— Geological, 8.
THURSDAY, 21st.—Royal, 8.30.
—— Royal Institution, 3. Prof. Odling, F.R.S., "On the Chemistry of Alkalies and Alkali Manufacture."
—— London Institution, 7.30. Lecture.
—— Chemical, 8.
FRIDAY, 22nd.—Royal Institution, 9. Mr. J. N. Lockyer, F.R.S., "On the Results of the last Eclipse Expedition."
—— Quekett Microscopical Club, 8.
SATURDAY, 23rd.—Royal Institution, 3. Mr. Moncure Conway, "On Demonology."

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THE CHEMICAL NEWS.

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ON THE NORMAL PARAFFINS.*

By C. SCHORLEMMER, F.R.S.

SOME of the results of this research have already been published in two previous communications.† It was there pointed out that the constitution assigned to the normal paraffins (*i.e.*, that they contain the carbon atoms linked together in a single chain) was ascertained partly by preparing them by synthesis from other normal compounds, and partly by studying the oxidation products of the alcohols obtained from them. The best method to prepare these alcohols is to pass a current of dry chlorine into the vapour of the boiling hydrocarbon; a mixture of a primary and a secondary chloride is obtained‡, and these, by heating the mixture with glacial acetic acid and potassium acetate to 200°, are completely decomposed, the primary chloride yielding the corresponding acetate, whilst the secondary compound partly splits up into an olefine and hydrochloric acid, and partly is converted into the acetate of the secondary radical. By treating the acetates with an alcoholic solution of caustic potash, the alcohols are formed, which can be only approximately separated by fractional distillation, as the difference between their boiling-points is only about 10°.

Pentane, or normal amyl hydride, C_5H_{12}, boiling at 37°—39°, is found in considerable quantity in Pennsylvania petroleum. The secondary pentyl alcohol or *methyl-propyl carbinol*, $\left.\begin{matrix}CH_3\\C_3H_7\end{matrix}\right\}CHOH$ (boiling-point 120°—122°), gives an oxidation *methyl-propyl ketone*, $\left.\begin{matrix}CH_3\\C_3H_7\end{matrix}\right\}CO$, which on further oxidation splits up into acetic acid and propionic acid. The *primary pentyl alcohol* is identical with the normal amyl alcohol, which Lieben and Rossi obtained from normal butyric acid, and yields on oxidation *normal valerianic* acid, boiling at 184°—187°.

Hexane, or normal hexyl hydride, C_6H_{14}.—(1) *Hexane* from petroleum, boiling at 69°—70°, yields the following derivatives:—(a) *Methyl-butyl carbinol*, $\left.\begin{matrix}CH_3\\C_4H_9\end{matrix}\right\}CH.OH$, (boiling-point 140°—142°), the oxidation products of which consist of *methyl-butyl ketone*, $\left.\begin{matrix}CH_3\\C_4H_9\end{matrix}\right\}CO$, and acetic acid and *normal* butyric acid. (b) *Primary hexyl alcohol*, boiling at 150°—155°, from which *caproic acid* boiling at 201°—204° was obtained.

(2) *Hexane* from mannite was obtained by acting with hydrochloric acid and zinc upon the secondary hexyl iodide prepared from mannite. It boils at 71·5°, and its sp. gr. at 17° is 0·6630. The derivatives were the same as those of the hexane from petroleum; it must, however, be stated that the boiling-points of some were a little higher than those of the petroleum hydrocarbon, and there was also a marked difference observed between the two caproic acids. That from mannite gave a well-crystallised barium salt, whilst that from petroleum could only be obtained in the amorphous state; but as the two secondary alcohols yield both normal butyric acid, the chemical constitution of the two hexanes must be the same.

(3) *Dipropyl.*—This hydrocarbon was prepared by acting with sodium on primary propyl iodide; boiling-point 69°—70°; specific gravity at 17° = 0·6630. The quantity obtained was too small for further investigation; but the mode of its formation shows that it must have the same constitution as the two other hexames.

Heptane, or normal heptyl hydride, C_7H_{16}; boiling-point 97·5°—99°. This hydrocarbon, which is also found in petroleum, gives a secondary alcohol (boiling-point 160°—162°), which is *methyl-pentyl carbinol*—

$$\left.\begin{matrix}CH_3\\C_5H_{11}\end{matrix}\right\}CH.OH,$$

as the acetone obtained from it yields on oxidation acetic acid and *normal valerianic acid*. The primary heptyl alcohol boils at 170°—172°; on oxidising it, *œnanthylic* acid, boiling at 219°—222°, was formed, which was found to be identical with the acid obtained from castor-oil.

Octane, or normal dibutyl, C_8H_{18}, is easily obtained by the action of sodium or normal butyl iodide. It boils at 123°—125°, and has at 17° the sp. gr. 0·7032. As the octane from methyl-hexyl carbinol, as well as that which Zincke obtained from primary octyl alcohol, have the same boiling-points and specific gravities, it appears most probable that these three hydrocarbons are identical.

* Abstract of a paper read before the Royal Society.

† *Proc. Roy. Soc.*, No. 123 (1870), and No. 219 (1871).

‡ The same mixture is obtained by the action of chlorine in the cold or in presence of iodine; but at the same time a large quantity of higher chlorinated substitution products is formed, which is not the case by acting with chlorine on the vapour.

ON THE ACTION OF HEAT UPON SOLUTIONS OF HYDRATED SALTS.

By CHARLES R. C. TICHBORNE, F.C.S., M.R.I.A., &c.

WHEN considering the dissociative action of heat upon water of hydration, some evidence was naturally sought amongst those salts which present a change of colour when passing from the dry to the hydrated state. The salts experimented with were those of cobalt, copper, and nickel.

As regards such bodies, it is a general characteristic that neutral solutions of any of their chlorides do not change colour on boiling the aqueous solutions at ordinary atmospheric pressure, nor does the amount of dilution affect the tint any further than what would be due to attenuation. But in no case where a colour-change is evinced between the dry and hydrated salt have I failed in obtaining a dehydration of the salt when using extraordinary pressure. Such chromatic changes differ from those produced by the basic condition of the salt, as will be seen further on.

Let us take, for instance, the dehydration of the salts of cobalt, which is evinced by a well-known change of colour, the conversion of the light rose colour into a dark and pure blue. My observations conclusively prove that waters of crystallisation or of hydration are easily held asunder in aqueous solutions by the dissociative influence of heat; that is to say, in a similar manner to the phenomena noticed as regards the bases or ultimate molecules in the trioxide group.* No amount of boiling will, however, convert a pink solution of cobalt into a blue one. But it was observed by Proust many years ago, that, on evaporating a *strongly acid* solution of a cobalt salt to a concentrated point, he got a permanently blue solution, which he considered was due to the abstraction of the water of hydration by the acid. Proust also stated that he had obtained from such a solution blue crystals, supposed to be the anhydrous salt; this requires verification.

Conceiving that the cobalt salts would, from their chromatic display, be most applicable to illustrate the dissociation of water of hydration by heat, I was rewarded by finding that it answered admirably for this purpose, and gave results which may be used as beautiful lecture experiments. The thermanalytic point of the cobalt salts being above 100° C., no result will be obtained on boiling a neutral solution; but if any substance capable of exerting an affinity for the water of hydration be introduced, the thermanalytic point of the salt will be lowered,

* Tichborne "On Molecular Dissociation." CHEMICAL NEWS, vol. xxiv., pp. 123, 199, 209, 220.

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as shown by Proust's experiment. Sulphuric and other acids, chloride of calcium and other hygroscopic salts, sugar, and other hygroscopic, but otherwise indifferent substances, act in a similar manner.

However, as the quantity of these dehydrants required to affect the cobalt solution was considerable, I used alcohol to lower the thermanalytic point. Chloride of cobalt* dried at 100° C., dissolved in pure and absolute alcohol, gives a magnificent pure blue, free from the slightest tinge of purple. For this purpose it is necessary that the alcohol should be free from water, and it is desirable to rectify from anhydrous sulphate of copper or chloride of calcium. The following instructive illustrations may be shown with chloride of cobalt:—

(1). A blue alcoholic solution obtained in the above manner is placed in a deep beaker, and water is cautiously poured down the side of the vessel. Two layers will be produced, of two different colours, and will remain in this condition for some considerable time by virtue of their different gravities. The upper layer will be blue, and contains the anhydrous salt; the lower layer will be pink, and contains the hydrated salt, rendered so by the direct addition of water.

(2). A beaker of the alcoholic solution which has been hydrated by the addition of a considerable amount of water is peculiarly sensitive to heat. If it is gradually heated upon a water-bath, it passes, as the temperature rises, through all the shades of pink and purple until a pure blue is produced, giving the same absorption spectrum as that obtained from the anhydrous salt. The thermanalytic point is so lowered by the alcohol present that the water of hydration of the cobalt salt is gradually but perfectly dissociated. If we now submerge this beaker half-way into a freezing mixture, we in a short time obtain similar chromatic and chemical results as in the first instance; but in this case the phenomena are brought about by different means. In the beaker we have two layers exhibited—the upper, or blue one, containing the anhydrous salt, the water being present, although dissociated.

(3). It was easy to portend that, although impossible at ordinary atmospheric pressure, and in an ordinary aqueous solution, to dissociate the water, it is only necessary to boil such a solution under a sufficient amount of pressure to obtain the thermanalytic point. This was demonstrated by the following experiment:—A weak solution of chloride of cobalt was sealed up in a glass tube, two-thirds of the capacity of which were empty. On boiling the liquid in this tube the solution gradually passes with the increment of heat through all the shades of purple until the contents ultimately become of a pure blue. Thus, in this aqueous solution we have attained, by extraordinary pressure, the temperature necessary for the separation of the water. The change of colour may be easily observed as it occurs in the capillary tube by holding any white material at the back of the tube and opposite the experimenter.

Chloride of copper, $CuCl_2$, gives a beautiful blue solution in water; this colour is characteristic of its hydrate. It gives a brownish yellow salt in the anhydrous state; its solution in alcohol gives a greenish yellow, or, better still, in pure ether which has been acidulated, a brownish-yellow appearance.

The beautiful blue solution of the neutral salt, when heated in a sealed tube to a high temperature, becomes gradually green, yellow, and ultimately a dark brown and nearly opaque liquid. As it cools, it gradually associates the water of hydration and passes again through all the shades; but when cool it becomes a little opalescent, from the formation of a bluish basic precipitate. Therefore, for illustrating this experiment it is better to use a slightly acidulated solution, which, from the presence of the acid, is even more sensitive to heat, and regains its original condition on cooling; hence this experiment can be performed with the same tube *ad infinitum*.

* Glycerine does not affect these salts. The composition of the hydrated salt is $CoCl_26H_2O$ (Marignac).

A solution of sulphate of copper, heated in sealed tubes, gives somewhat similar results as regards dehydration; but a basic salt is at once determined, even in an acidulated solution.

The nickel salts do not, as a rule, so strikingly illustrate this phenomenon of chromatic change, although, as well known, the hydrated salts are green, and the anhydrous salts more or less yellow. Heated under pressure, the chloride seems to be intensified in colour in the first instance, then becomes yellow, and ultimately a dark yellowish green. This, at first sight, would appear somewhat anomalous; but on examination its anhydrous alcoholic solution presents similar anomalies on cautiously adding a weaker alcohol.

It is necessary in these experiments that considerable caution should be used, as an explosion frequently occurs. As wire gauze would prevent the gradual change in colour from being observed, it is better to heat the experimental tube in a second glass one considerably larger. The experimental or hermetically-sealed one should be as small in calibre as the necessary observations will allow of. The volume of liquid necessary for proper observation will of course depend upon the depth of colour of the solution, and the amount of solution should have a small proportion to the capacity of the tube. Tubes for this purpose are best made by taking a white glass tube of some considerable strength, and drawing this out until it has a diameter of $\frac{1}{10}$ths of an inch. My attention was first drawn to the value of capillary tubes for experiments similar to the above from a lecture delivered by Dr. Andrews.*

The most important observations made in connection with this investigation is the distinction observed between the effects of dilution in colour-changes attending the basic condition and in colour-changes attending dehydration. As it might have been predicted, it is exactly the reverse in one case to the other. In a report recently read at this Academy, I pointed out that chromatic changes resulting from the formation of basic salts by dissociation (*i.e.*, chromic and ferric salts) is influenced by dilution lowering the thermanalytic point; this is due to the basic action of the water itself. But it is self-evident that an increased volume of water will act differently in cases where the change of colour depends upon dehydration. In the first class, the increase of volume in the water will assist the dissociation and lower the thermanalytic point; in the second case, the increase in the volume of water retards the dissociation and raises the thermanalytic point. In the first class of phenomena the dissociatability is in ratio to dilution; in the second class it is in inverse ratio to dilution. The thermanalytic point may be determined approximatively by taking a capillary tube containing the salt to be tried, and putting this into a tube containing a mixture of chloride of calcium and glycerine; this gives a bath which will carry the temperature over 200° C. Heat is now carefully applied at the same time that the temperature is determined by a thermometer, which can be used to keep the whole moving. An observation made with chloride of cobalt is placed in juxtaposition with ferric chloride to illustrate these remarks.

Dissociation Attended with a Basic Result, Fe_2Cl_6.

Percentage of Salt in Water (Hydrated).	Temperature of Dissociation. ° C.	Colour.
50	over 100	—
10	94	—
5	82	—

Dissociation of Hydrated Water, $CoCl_2$.

Percentage of Salt in Water (Hydrated).	Temperature of Dissociation. ° C.	Colour.
50	60	change.
	100	blue.
25	85	change.
	135	blue.
10	180	change.
	207	blue.

* "On the Continuity of the Liquid and Gaseous States of Matter." CHEMICAL NEWS, vol. xxi., pp. 101, 111.

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The dissociation, therefore, of water of hydration of salts when in solution is gradual, and progresses with the increment of temperature until perfect dehydration takes place. It is evident, also, that in the salts tried perfect dissociation takes place at a higher point than the boiling-point of water when operating at ordinary pressure. With very concentrated solutions it becomes difficult to determine how far dissociation of the more ultimate molecules may play an exceptional part in the decomposition. Lastly, we also perceive that dilution raises the thermanalytic point, as regards the molecules of hydration.

ON A FORM OF ELECTRO-MAGNETIC SEISMOGRAPH ADAPTED FOR INDICATING AND REGISTERING MINUTE SHOCKS.

By WILLIAM. SKEY,
Government Analyst, New Zealand.

FROM what I can learn the kind of electro-magnetic seismograph now in use is merely an adaptation of certain electro-magnetic instruments to the old mercurial seismometer, in which the movement of the mercury, as during an earthquake, joins the metal to a wire suspended near it, and so closes the circuit of a voltaic cell or battery, in doing which an electro-magnet is set to work for registering the turn and direction of such movement.

An instrument of this description I have recently been experimenting with, and I experience a very great difficulty in adjusting the distance of the mercury from the wire so as to enable the instrument to indicate shocks—except these are of some considerable violence relatively speaking; and, again, I find there is the danger of the two permanently adhering, so that only the first shock of a series might be registered; there is besides, as is well known, compensatory apparatus required on account of changes of temperature. This deficiency in delicacy and these other defects of this instrument I have therefore sought to remedy by considerably modifying it in several of its parts; the principle to which I have worked, and that which alone is novel in its introduction here, being that of enforcing the earthquake to *break*, in the place of *closing*, an electric circuit. For this method of using the electric current I find it far the best to use solid metal for both sides or parts of the break in place of one fluid and one solid as used hitherto.

The following is a short specification of the instrument I have designed to fulfil these objects, and which, in its present or modified form, I would, from a knowledge of its capabilities, beg to recommend to those interested (scientifically) in the phenomena alluded to:—

A small block of metal, having a thin slip of platina attached, or a small wire of this metal projecting a little apart from it horizontally, is connected with an electro-magnet with keeper suspended, and this with a single cell of a battery.

A very fine silver wire (that used for sewing wounds), 3 feet long or so, joined at its lower extremity by a little platina wire, depends from a point above, so that the two platina wires may intersect; a firm adjusting screw or other apparatus set contiguous to the point of suspension enables one to put this point in such a position that these wires are allowed to press but very slightly upon each other. The silver wire is connected with the other pole of the cell through this point of suspension through a vertical galvanometer. The shock-receiving part is placed underground to avoid the interference of winds or that of violent detonations, the metal block being set upon a wooden pile driven some distance in solid earth.

When properly set a single make and break contact of this kind is so sensitive that the impact of 3 pounds of stone, falling from a height of 5 feet upon the ground, at a distance of 50 feet from it, moved the needle of the galvanometer very determinately. The intervening ground was clay.

In using a series of these and the needle of the galvanometer, it seems advantageous, in order that the needle may be kept in a determinate position during periods of quiet, to use only one galvanometer for the breaks of the opposite quarters, and but one cell, dividing the current of this cell equally between the two breaks, and passing each portion oppositely through a separate coil on either side of the needle. Thus the needle once set at zero cannot move far from it, except during shakes, no matter how the intensity of the current varies. On the top of each needle a wire rests in such a manner that it drops vertically when the needle is deflected a little to either side, fixing the needle one side or the other of it according to the direction the shake moves in. In order to obtain distinct indications as to the direction of a shake with an instrument of this kind, it seems necessary to place the breaks a considerable distance apart from each other. It is very probable that, if required, very much greater delicacy would be given to this instrument by largely increasing the number of breaks (or shock-receivers) and connecting them throughout with a single cell or battery in such a manner that, were any one of them to disconnect, the circuit stops. In this way it is thought that a shock so very slight as to be quite unable to break any of these contacts would largely reduce the area of contact through the system, and so considerably curtail the flow of the current for the period of such shake, thus giving an indication of this, where otherwise it would be unrecorded.

* Read before the Wellington Philosophical Society, November 25th, 1871.

ON THE ACTION OF LOW TEMPERATURES ON THE SO-CALLED SUPERSATURATED SOLUTIONS OF SODIC SULPHATE.

By L. C. DE COPPET, Ph.D.

IN the last number of the CHEMICAL NEWS (vol. xxv., p. 102) appeared a paper by Mr. Charles Tomlinson on a paper to which I have devoted much attention during the past two years, viz., "On the Action of Low Temperatures on Supersatured Solutions of Glauber's Salt." I believe the following to be a fair *resumé* of Mr. Tomlinson's paper; I make it chiefly in the author's own words, italicising the more important passages.

When a solution of 1 part, 2 parts, or 3 parts of Glauber's salt to 1 of water is cooled to 26° F. and under, "crystals of a peculiar opaque white" are deposited. These crystals are "not like the transparent octahedra that are thrown down when these solutions cool to 40° F. and under," but "resemble in texture newly formed white-lead." "*At whatever temperature they may be formed below 26° F., their formation causes the thermometer to rise to 26°, and that, too, in solutions of 1 part, 2 parts, or 3 parts of salt to 1 of water.* This opaque salt is sometimes amorphous, and then it covers the surface of the flask like thick whitewash. This effect occurs when the flask is much agitated in the freezing mixture."

"Thus," says Mr. Tomlinson, "*one more hydrate is added to those already known as belonging to this remarkable salt. It doubtless contains less water than the seven-atom hydrate; but I know of no method of testing its hydration, since its existence depends upon the low temperature and shelter from the action of nuclei.* In this way it resembles the various hydrates described in my paper in the *Transactions*."

Mr. Tomlinson mentions M. Violette as the only writer who has noticed the formation of this new

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hydrate "qui cristallise difficilement en forme de choux-fleurs."*

In the course of my experiments on the congelation of saline solutions, ordinary and supersaturated,† I have made the phenomena described by Mr. Tomlinson the subject of careful investigation, and do not hesitate in affirming that both he and M. Violette have misunderstood their true nature. The supposed new hydrate of sodic sulphate is simply *ice* mixed with variable quantities of the long since discovered seven-atom hydrate, $Na_2SO_4,7H_2O$.

To make this clear I must enter into a few explanations.

When a saline solution is cooled to a sufficiently low temperature, it freezes—*i.e.*, the water of the solution is changed to ice (Blagden, Despretz, Rüdorff). Water containing saline substances in solution freezes at a lower temperature than pure water; the depression of the freezing-point increases with the quantity of substance, and is, in many cases, in exact proportion to the quantity of salt dissolved.

A solution may very easily be cooled without freezing to temperatures many degrees below its freezing-point, but under no circumstances can the water of the solution be made to congeal at temperatures *above* the freezing-point. In the former case, as soon as ice begins to form, the temperature rises to the freezing-point, and there remains stationary for some time; then it begins to fall again slowly, because, as more ice is separated from the solution, the latter becomes more concentrated and the freezing-point is gradually lowered. Hence the exact determination of the freezing-point is an operation requiring some care.‡

When, however, in a saturated or supersaturated solution salt crystallises at the same time the water freezes, then, in the majority of cases, the temperature does not sensibly vary until all the water is frozen; the solution yields up the salt in the solid form as fast as the water freezes, so that the concentration of the solution remains throughout unchanged. The temperature marked by the thermometer under these circumstances *is the freezing-point of the solution normally saturated with the salt that separates.*

The following table contains part of the results of my experiments on the temperature of congelation of solutions of sodic sulphate. A single asterisk attached to the numbers in the first column indicates that the solution is "supersaturated"‖ with Glauber's salt, $Na_2SO_4,10H_2O$; a double asterisk indicates that the solution is supersaturated with the seven-atom hydrate, $Na_2SO_4,7H_2O$. The numbers printed in larger type refer to the normally *saturated* solutions of $Na_2SO_4,10H_2O$ and $Na_2SO_4,7H_2O$.

Weight of anhydrous sodic sulphate in 100 of water.	Freezing-point. °C.
2·00	−0·60
4·00	−1·20
5·00*	−1·40
6·10*	−1·70
10·00*	−2·75
12·20*	−3·05
14·50*	−3·55
15·00**	−3·65
20·00**	−4·50

It will be seen from the foregoing table that the normally-saturated solution of Glauber's salt freezes at −1·2° C. (29·8° F.),* and the normally saturated solution of the seven-atom hydrate at −3·55° C. (25·6° F.); the first contains 4·0, the second 14·5 parts, of anhydrous sodic sulphate to 100 of water.

The solution containing 20 parts of anhydrous salt to 100 of water (0·608 of Glauber's salt to 1 of water) freezes at −4·5° C. (23·9° F.). It is exceedingly difficult to make this solution freeze without depositing crystals of the seven- or ten-atom hydrates; I succeeded only once, after more than twenty trials. Almost as soon as the ice begins to form, the seven-atom salt is generally thrown down suddenly, the solution becomes normally saturated with this hydrate, and the temperature rises to −3·55° C. (25·6° F.). If later the crystallisation of the ordinary ten-atom salt sets in, the thermometer does not stop at −1·2 C. freezing-point of the saturated solution of this hydrate), but very often rises far beyond. The reason of this is, that in such strong solutions the greater part of the water is required to form the ten-atom hydrate, and but little is left to form ice. But when the solution is less concentrated—when it contains, say, 5 or 6 parts of anhydrous salt to 100 of water—as soon as the crystallisation of the ten-atom hydrate sets in (the congelation having previously begun) the temperature rises from −1·4° or −1·7° C. (see the Table) to (very nearly) −1·2° C., and there remains stationary until almost all the water is frozen.

The ice which separates from a concentrated saline solution is always more or less charged with salt, which, being deprived of its solvent, is forced to separate in the solid state. The appearance of the ice formed, under different circumstances, in one and the same solution often varies greatly, according to the greater or less quantity of salt with which it is mixed. If the quantity of the latter is large, the ice is opaque white or coloured, according to the nature of the salt;† the smaller the quantity of salt, the more the ice resembles that formed in pure water. When the solution is gently agitated during the congelation, and the temperature of the freezing mixture is not too low, the greater part of the salt, as it separates, falls to the bottom of the vessel, while the ice, being lighter than the solution, all rises to the surface of the liquid. The more dilute the solution, and the more slowly and carefully the experiment is conducted, the smaller the quantity of salt found in the ice when this is taken out and melted.

The reader will now readily understand why the temperature of Mr. Tomlinson's solutions always rose to 26° F. as soon as the "new hydrate" began to form. The reason is that 26° F. (*or* 25·6° F.) *is the freezing-temperature of the saturated solution of* $Na_2SO_4,7H_2O$, and that all the solutions in Mr. Tomlinson's experiments had thrown down some of this hydrate.‡

If Mr. Tomlinson, when he repeats his experiments, will avoid using a freezing mixture at a temperature lower than −6° C. (21° F.), and keep the solution continuously, though gently, agitated, so that the temperature be uniform throughout the liquid, he will find—

* I will add that the temperature at which M. Violette observed the formation of the crystals "en choux-fleurs" was about −4° C. (24·8° F.); they proved to be lighter than the solution, for when detached by agitation from the sides and bottom of the vessel, they rose to the surface of the liquid.

† My first paper on this subject has been published in the *Annales de Chimie et de Physique*, 4me série, t. xxiii., p. 366.

‡ Rüdorff is the author of the only satisfactory method known for determining with accuracy the freezing temperature of a saline solution. I have shown (*loc. cit.*, p. 403) how this method can be made applicable to supersaturated solutions.

‖ When I speak of a solution as being *supersaturated* with a certain salt at a given temperature, I only mean that it is more concentrated than the *saturated* solution of the same salt at the same temperature. I make no hypothesis as to the condition of the salt *in* the solution.

* I believe all the temperatures in the table to be exact within less than 5-100ths of a degree.

† See, on this subject, the very interesting experiments by Rüdorff in Poggendorff's *Annalen*, Bd. 116.

‡ Mr. Tomlinson says that in his first experiment, with a solution of 1 part of Glauber's salt to 1 of water, the formation of the "new hydrate," which began at 19° F. (−7·2° C.), caused the temperature to rise to 26° F. When the flask was transferred to water at 48°, the opaque white crystals broke up into an amorphous woolly mass. As the temperature of the solution rose to 40°, then for the first time the usual transparent octahedra of the anhydrous salt fell down." In this there must be some mistake. The freezing-point of the solution of 1 part of Glauber's salt to 1 of water (28·3 of anhydrous salt to 100 of water) is certainly below 23° F. (−5° C.). If, therefore, the temperature rose to 26° F., and there remained stationary, it must be that crystals of the seven-atom hydrate were present in the solution. The "transparent octahedra of the anhydrous salt" are, as I shall presently show, not crystals of the anhydrous salt, but of the seven-atom hydrate. Mr. Tomlinson first observed them when the temperature had been raised and the ice melted; but they must have been thrown down before this, or the temperature during the congelation could not have risen to 26° F.

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(1). That under no circumstances can the supposed "hydrate" be made to crystallise at a temperature higher than 26° F.

(2). That where a certain quantity of this "hydrate" has formed, the whole of it will in time disappear if the temperature of the solution is raised ever so little above 26° F.

(3). That the transparent crystals at the bottom of the flask will not become "opaque white,"* and the "hydrate" will not adhere to the bottom of the flask; but, as fast as it forms, it will rise to the surface of the liquid. In the meantime, the quantity of seven-atom salt will go on constantly increasing, and the greater part of it will collect at the bottom of the flask; the thermometer will mark steadily 25·6° F. (within one-tenth of a degree) until the layer of floating ice meets the layer of salt at the bottom, and the whole mass is nearly solidified. Then only will the temperature begin to fall below 25·6° F.

Before closing I must call attention to an error which occurs in several of Mr. Tomlinson's papers.

When a supersaturated solution of sodic sulphate is cooled to a sufficiently low temperature, it throws down transparent crystals resembling octahedra. Mr. Tomlinson always describes them as crystals of the *anhydrous* salt, whereas in reality, they are crystals of the *seven-atom hydrate*. The salt, $Na_2SO_4,7H_2O$, crystallises in rhombic prisms, $\infty P.\infty \overline{P}3.\infty \breve{P}\infty$, terminated by $\breve{P}\infty.\frac{1}{2}\breve{P}\infty$.† The angles, $\infty P : \infty P$ (macr.) = 87° 20', and $\breve{P}\infty : \breve{P}\infty$ (basal) = 88° 0', so that when, as very often happens, the faces, $\breve{P}\infty$, are sufficiently developed, the crystals assume the appearance of quadratic pyramids with truncated summits ($\infty \breve{P}\infty$).‡ The crystals of $Na_2SO_4,7H_2O$, which are thrown down suddenly have generally this pyramidal or octahedral appearance; but I have often seen prismatic and pyramidal crystals thrown down together, and I have seen pyramidal crystals, as they grew larger, assume the prismatic shape. Both pyramids and prisms become opaque white when touched with the ten-atom salt, and in every other respect their properties are identical.

The crystals of anhydrous sodic sulphate which form in hot solutions when these are evaporated are rhombic octahedrons; but they do not in the least resemble the octahedral-looking crystals of the seven-atom hydrate. All those I have seen were turbid, never transparent.

There are two distinct varieties of anhydrous sodic sulphate, both of which can exist at temperatures below 33° C. One of these modifications is several times more soluble than the other. When the less soluble anhydrous sodic sulphate is heated to above 33° C. it is transformed into the more soluble modification.‖ Both varieties combine with cold water, the less soluble one forming the ordinary ten-atom or Glauber's salt. From some of Löwel's observations, it would appear that below 18° C. the more soluble modification in contact with water is gradually transformed into the seven-atom hydrate. I have not yet been able to determine the composition of the hydrate formed by the more soluble modification between 18° and 40° C. Above 25° C. it cannot be the seven-atom hydrate, for Löwel has shown that this salt is destroyed at that temperature. The quantity of water taken up between 18° and 40° C. seems to vary with the temperature, the relative quantities of salt and water, and the length of time they are left in contact.

The two varieties of anhydrous sodic sulphate and the ten- and seven-atom hydrates are the only well-defined modifications of sodic sulphate which have yet been discovered.

Paris, March 6, 1872.

* Unless, of course, crystallisation of the ten-atom salt sets in. As is well known, crystals of the seven-atom hydrate become opaque when touched by the ten-atom salt.

† Watts's "Dictionary of Chemistry," vol. v., p. 612.

‡ Compare Fig. 267 in Watts's "Dictionary of Chemistry," vol. ii., p. 147.

‖ See CHEMICAL NEWS, vol. xxiii., p. 266.

THE ESTIMATION OF COMBINED CARBONIC ACID IN WATER.*

By EDWARD NICHOLSON,
Analyst of Waters, Mysore, Northern, and Ceded Districts.

A PRACTICALLY easy process for the estimation of the carbonic acid existing in water as carbonate or bicarbonate being most desirable, I have lately begun examining the processes which seemed most likely to be of use. Amongst others, I have examined a process quoted in Dr. Parkes's "Manual of Hygiene." It is a volumetrical process devised by M. Lory, and its performance is thus described:—

"(1). Precipitate copper phosphate from the bichloride by sodium phosphate. Wash precipitate, suspend in water, and dissolve in slight excess of HCl, adding the acid drop by drop.

"(2). Dissolve 0·265 grms. of pure dry sodium carbonate in 1 litre of water for a test solution, and pass through it a current of CO_2.

"(3). Take 100 c.c. of the test solution, and drop in the copper solution until the cloud first formed is re-dissolved. Read off amount of copper solution used, and dilute if necessary, so that the 100 c.c. of test solution shall exactly take 4·4 c.c. of the copper solution. In testing water take 100 c.c. and seize the exact moment of the disappearance of the cloud. Read off the amount of copper solution used, and calculate as follows:—1 c.c. = 0·006 of sodium carbonate or 0·00566 of calcium carbonate. To find the CO_2, multiply the c.c. used for 100 c.c. of water by 0·5; the result is centigrammes of CO_2 per litre existing as bicarbonate."

On examining the reaction, it is evident that the phosphate of copper has little or nothing to do with it. This substance dissolves in hydrochloric acid without alteration, and on the solution being dropped into any fluid of alkaline reaction, the phosphate of copper precipitates by the withdrawal of the free acid which held it up. If more of the acid solution is added, the precipitate increases until the fluid becomes neutral, and then an excess will gradually take up again the precipitated phosphate of copper. This is necessarily anything but a sharply defined action, for the acid solution, if prepared as directed, is already nearly saturated with phosphate of copper, and requires to be added in considerable excess after the fluid under examination has become neutral. Using such a solution, I found that whereas 1·0 c.c. neutralised a certain quantity of alkaline fluid, no less than 2·0 c.c. were required before the cloud began to clear away perceptibly, and above 3·0 were required to produce complete re-solution of the precipitate. With a solution containing about twice as much acid as was requisite to dissolve the phosphate of copper, the reaction was much more distinctly shown, but still a considerable excess had to be added after perfect neutralisation of the alkaline fluid; whilst acid reaction was shown by litmus-paper at 1·0 c.c., at least 1·4 c.c. had to be used in order to remove the turbidity. The phosphate of copper not entering into the alkalimetrical reaction is merely a substitute for tincture of litmus and not a good substitute nor a well applied one, as the solution is really analogous to standard sulphuric acid coloured by litmus. Now, no one would think of using litmus in that way, and yet this is all the novelty in the process, a substitution of dilute hydrochloric acid coloured by phosphate of copper for dilute sulphuric acid coloured by litmus. I tried using the saturated solution in the same way as tincture of litmus, adding a few drops as a preliminary to ordinary volumetrical estimation by a standard solution of sulphuric or oxalic acid; the excess of acid used to re-dissolve the precipitate at the end of the reaction being equal to that originally introduced along with the phosphate of copper, no correction being necessary. This is the best way of using the phosphate of copper; but I cannot see any advantage

* From the *Madras Monthly Journal of Medical Science* for October, 1871.

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in it over tincture of litmus, and the end of the reaction s not nearly so exactly shown as it is by litmus-paper. Using a dilute solution of sulphuric or oxalic acid, and testing the progress of the reaction by touching sensitive litmus-paper with the glass stirring-rod, great precision is attainable, alkalinity being readily estimated to 1 milligramme of carbonate of soda per litre of water.

M. Lory's process is a disadvantageous modification of the ordinary alkalimetry; it has also nothing to do with carbonic acid except in an indirect manner, any solution of alkaline reaction giving similar results whether it contains caustic alkali, a carbonate, a bicarbonate, a silicate, a phosphate, or a borate, or even a mixture of two or more of these salts.

Now, natural waters contain silicates just as often as carbonates, and sometimes in quite as large amount; alkalimetrical processes applied to them will then give the amount of bases combined with silicic and carbonic acids. If silicic acid combined with bases in as simple proportions as carbonic acid does, there would be no difficulty in obtaining the amount of carbonate by deducting the amount of silicate corresponding to the silica as determined by weight. Unfortunately, silicic acid combines in so many different proportions that it is exceedingly difficult to deduce from the weight of the silica how much base it was combined with.

The direct determination of carbonic acid is a matter of no small difficulty. The only courses open at present are—

(1). Precipitation of carbonic and silicic acids together by lime-water or ammoniacal chloride of barium, and estimation of the carbonic acid in the precipitate; this estimation may be done in two ways—either directly, by determining the loss of weight on decomposition by a strong acid in one of the light flasks usually employed for this purpose, or indirectly by conversion of the precipitate into sulphate and calculation of the carbonic acid.

(2). Extraction of the carbonic acid and direct measurement in the gaseous state. This is the most exact course to follow, as it can be divided into two estimations—that of the gas which is free or is present as the second equivalent of acid in the bicarbonates, yielded by simple ebullition; and that of the carbonic acid retained by the carbonates, yielded on further ebullition after addition of a strong acid. The apparatus required is, however, rather complicated, and so much care and time are required that this method can only be carried out in a well-appointed laboratory.

NOTES OF

DEMONSTRATIONS ON PHYSIOLOGICAL CHEMISTRY AT ST. GEORGE'S HOSPITAL.

By S. W. MOORE.

XV.

If, as already explained, we place between the light and the slit of the spectroscope a layer of coloured fluid, a phenomenon known as absorption takes place; this is different, not only for differently coloured bodies, but for similarly coloured bodies from different sources; so varied are these appearances that individual bodies can be immediately recognised. Animal fluids and colouring matters may thus be identified.

Blood may be taken as a type of absorption-bands; a dilute solution in water gives in the yellow, about the position of the sodium or D line, a band, and another one immediately on the green, and cuts off the violet end of the spectrum.

Chemical changes in the constitution of bodies may be seen with this instrument. Arterial blood, as described above, giving two bands, may be reduced by H_2S or the alkaline tartrate of iron, and then the two bands become merged into one large broad one. This is exceedingly interesting to the physiologist, because it affords an explanation of the process of respiration as it takes place in the lungs.

If the ear of any albino, say a young white rabbit, be interposed between the spectroscope and a strong light (Drummond's), the first, or oxygenated spectrum may be seen; if, while under observation, the animal be suffocated with CO_2, the second, or venous spectrum, will then be seen.

The spectroscope also determines how certain poisons act; thus CO, H_2S, HCN, and others combine with the blood and produce new spectra, proving that it is not the absence of oxygen, *i.e.*, suffocation, that is the cause of death.

By the micro-spectroscope a corpuscle may be analysed with as much certainty as a larger quantity. The bile gives a definite spectrum, especially when treated with Pettenkofer's test; the cholochrome and the biliary acids are capable of differentiation. The urochrome, or colouring matter of the urine, which, as previously described, may be converted into several compounds, is readily recognised, as are the derivatives. To fluids supposed to contain these things the application of the spectroscope at once settles the question, as, for instance, blood in urine.

The vegetable world gives very characteristic spectra in the very many compounds it produces, a most beautiful and interesting one being derived from chlorophyll or leaf-green extracted by alcohol from any green vegetable matter. The anilines also afford a variety of spectra.

From the numerous spectra that occur in nature it is not difficult to imagine that of necessity some two or three must resemble one another, if not identically, yet so closely that mistakes may easily be made. Thus blood and the extract of alkanet root are very similar, requiring for their distinction a great dispersion and good measuring capacity.

The whole subject is yet in its infancy. Though much has been done by many able workers, a vast field of inquiry remains still untouched; and I doubt not that this instrument will assume, before long, as much importance in the hands of the physician and surgeon as the microscope does at the present time.

These very brief and superficial statements profess no more than to call attention to a subject much neglected, and to direct the inquirer's mind to the proper path whereby greater facts may be elucidated.

NOTE ON THE DIGESTION OF MINERAL SUBSTANCES.

By RICHARD V. TUSON, F.C.S.,
Professor of Chemistry at the Royal Veterinary College.

Physiologists and chemists have hitherto entertained the belief that the principal if not the sole function of the pepsin and acid contained in the gastric juice is to render soluble the albuminoid constituents of food, and thus prepare them for the subsequent process of absorption.

Conceiving, however, that it would be extremely interesting to study the effect, if any, of the solvent constituents of the gastric juice upon mineral substances, especially those employed as medicines, I have set myself the task of investigating this subject. The inquiry is as yet but in its infancy; nevertheless the results already obtained are sufficiently positive and striking to induce me to "claim date" by placing on record the following experiments:—

Expt. 1.—A mixture of calomel* and distilled water containing 2 per cent of hydrochloric acid.

Expt. 2.—A mixture of calomel, pepsin,† and distilled water.

* The calomel employed in all the experiments was previously tested as to its purity.

† *Pepsina porci* prepared by Messrs. Bullock and Reynolds.

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Expt. 3.—A mixture of calomel, pepsin, and distilled water containing 2 per cent of hydrochloric acid.

These mixtures were placed in glass vessels, and kept at 38° C. (100·2° F.), *i.e.* about the temperature of the body, for twenty-four hours, during which time they were occasionally stirred or shaken. They were then thrown on to filters of Swedish paper, and the filtrates saturated with hydrosulphuric acid.

The filtrate from experiment 1 remained unaltered.

" " 2 " "

" " 3 yielded a black precipitate of sulphide of mercury.

The results of these experiments, therefore, show that neither dilute hydrochloric acid (2 per cent) nor pepsin alone is capable of dissolving calomel, but that when these agents are mixed they do effect its solution, and, consequently, that the digestion of calomel, so far as its solution in artificial gastric juice is concerned, is brought about under the same conditions as that of the albuminoids.

The importance of this observation will become apparent when it is borne in mind that it offers an additional explanation to those already published of the manner in which calomel enters the circulation, in order that it may exercise the many therapeutic actions with which it is accredited.

Whether or not oxide of antimony, sulphide of antimony, and other so-called insoluble remedies are dissolved by pepsin and dilute acid, is a problem which yet remains to be solved.

The influence of different acids, the chemical characters of the dissolved mineral and its behaviour when subjected to dialysis, and the action, if any, of peptones on inorganic bodies, have also to be determined, but these matters, together with many others, will form the subject of future communications.—*Lancet.*

THE SPECTRA OF MANGANESE IN BLOWPIPE BEADS.

By CHARLES HORNER.

MANGANESE may be readily detected in most minute quantities by its spectra in blowpipe beads. The following is the best method of preparing them:—Sufficient chlorate of potash should be volatilised in the loop of platinum wire to form a bead about the size of a pin's head, then take up the merest trace of the oxide and fuse it; next add enough chlorate to fill the loop, and very gently flame the bead for a few seconds and withdraw, when it crystallises a delicate pink colour. In adding the second portion of chlorate care must be observed not to volatilise the salt, and the best result is when the bead does not much exceed the thickness of the wire. If after adding the second portion we volatilise the chlorate, we immediately obtain a greenish coloured bead of manganate of potash, and more transparent than the pink bead.

In order to see the spectra of these beads, they should be examined by the spectrum microscope and strongly illuminated. The pink bead exhibits several absorption-bands more or less definite according to the amount of manganese present. The three most distinct bands, however, lie between D and *b*, and may be seen when the bead is scarcely coloured. This spectrum very closely resembles that given by the crystals of perchlorate coloured by permanganate of potash, but the bands are slightly more refrangible in the former. The green bead gives a spectrum of two bands, one broad band covering the sodium line, and a very narrow band in the orange ray. This spectrum test is most useful in the examination of minerals, for although the pink colour is sometimes disguised by the presence of other substances, as in rhodonite, which communicates a yellowish tint to the bead, yet the three principal absorption-bands are plainly visible.

METALLIC MANGANESE.

By J. ENEU LOUGHLIN, M.D.

THE preparation of metallic manganese has been effected in a variety of ways; the most convenient methods are those requiring crucible operations.

Gahn first succeeded in obtaining the metal from peroxide of manganese by mixing it with charcoal and oil, forming the mass into pellets, which were introduced into a brasqued crucible and heated for three-fourths of an hour in a forge.

Silliman, in his "Elements of Chemistry," vol. ii., p. 174, states, "Faraday obtained metallic manganese by simply heating the tartrate alone, and by passing hydrogen gas over the heated oxide."

With a view of obtaining metallic manganese in a pure condition, I have examined,

1st. *The Process of Deville*—heating pure manganese oxide with about 1-10th its weight of sugar charcoal in a lime crucible, placed in a brasqued crucible; heating for three hours at a dull white-heat. The product obtained was of a brownish colour, very brittle, possessed a sp. gr. of 7·95, was violently acted upon by sulphuric acid with disengagement of hydrogen gas; the powdered mass scarcely decomposed water at 200° F., but upon re-heating and powdering the mass, decomposition of water was slowly effected at 150° F., and the sp. gr. of the mass rose from 7·95° to 7·98°. The metal obtained by this process was extremely brittle, with a brownish-red lustre; viewed with a lens it had the appearance of being composed of many small nodules aggregated. This method yields very good results. The lime crucible might be replaced advantageously by one of porcelain.

2nd. *The Method of Brunner*, involving the employment of metallic sodium, did not succeed well in my hands, the only compensation received for a vast amount of labour being 5 grains of a metal possessing great hardness, sp. gr. 7·20, and a lustre resembling white cast-iron.

The two following are those from which I have derived the best results:—

(1). 50 grs. pure oxide of manganese, prepared from carbonate of manganese, was mixed with 25 grs. of cyanide of potassium and 15 grs. of animal charcoal, placed in a small porcelain crucible, which was introduced into a brasqued crucible and kept at a dull white-heat for two hours; the crucible being removed, was found to contain a dark, almost black, mass loosely aggregated, presenting several metallic points; sp. gr. 7·94. The whole mass was then powdered, slightly washed with ice-cold water, mixed with powdered animal charcoal, and heated for two hours at a dull white-heat; a very brittle mass was obtained of a sp. gr. 7·99, brownish-black lustre, decomposing water very slowly at 100° F., easily acted upon by sulphuric acid, and presenting no marks of crystallisation.

(2). 50 grs. of peroxide of manganese, mixed with 100 grs. of powdered charcoal, were made into a paste with castor-oil, divided into small *balls*, introduced into a porcelain crucible contained in a brasqued crucible, and kept for one hour at a dull white-heat. The mass obtained was of a brown, almost black colour, loosely aggregated, and of a sp. gr. 7·84. The mass was well powdered, mixed with charcoal, and re-heated for two hours at a dull white-heat. The mass obtained was still very dark, of a cast-iron appearance, more aggregated than previously, and of a sp. gr. 7·96, an increase of 0·12.

The mass was again mixed with charcoal and heated for 1½ hours at a dull white-heat, when the mass was found to have changed in colour to a brownish-red, with a lustre resembling that of dulled bismuth—to have become quite brittle; sp. gr. 7·98 an increase of 0·02. This product, not being as compact as desirable, was mixed with 10 grs. of borax and 5 grs. of charcoal, and heated for two hours at a white-heat, when a fine compact mass was obtained, showing evident marks of fusion

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upon the edges; colour resembling that of bismuth, showing upon fracture an appearance like cast-iron; sp. gr. 7·993, an increase of 0·013; scarcely tarnished in dry air; in moist air tarnishing readily, becoming covered with a dark brown powder; violently acted upon by sulphuric acid with disengagement of hydrogen gas, and effecting decomposition of water slowly at 100° F., energetically at 212° F.

From the above carefully recorded experiments I think we are warranted in asserting that the task of producing perfectly pure manganese is one of great difficulty. Indeed, the discrepancy between the specific gravities, ranging from 6·85 to 8·015 as given by different experimenters, leads us to suppose that we are dealing either with manganese under vastly different molecular forms; or, that many chemists have been duped into considering a compound of manganese with manganese indifferently oxidised as metallic manganese proper, and assigning to it certain definite metallic characteristics.

From my experiments upon the mass produced by process No. 2, a mass possessing a sp. gr. of 7·84 raised by successive heatings through the numbers 7·96, 7·98, 7·993, with like physical and chemical changes, I am led to consider the mass with a sp. gr. 7·84 as representing a compound of metallic manganese with manganese more or less oxidised, constituting for the time being, a veritable chemical compound, susceptible of decomposition under the influence of heat and carbon. This compound, under the influence of the decomposition by heat and carbon, passes through progressively decreasing stages of oxidation and progressively increasing stages of metallisation. There are also reasons for supposing that manganese may exist under various molecular conditions; under any other hypothesis it would be difficult to allow the existence of a metallic manganese of sp. gr. 7·13 as prepared by Brünner, and one of sp. gr. 8·015 as prepared by Deville; *both* presenting certain well-marked physical and chemical characters.—*American Chemist.*

PROCEEDINGS OF SOCIETIES.

GLASGOW PHILOSOPHICAL SOCIETY.
(Chemical Section).

Ordinary Meeting, Monday, March 11th, 1872.

Dr. William Wallace, F.R.S.E., President, in the Chair.

"*On some Experiments with the Fehling's Copper Solution*," by Dr. T. L. Patterson. This paper, and the discussion which followed, will be inserted in our next issue.

"*On Recent Views regarding the Composition of Ultramarine*," by E. M. Dixon, B.Sc.

The object of this paper was to bring under the notice of the members the views advocated by Stein respecting the constitution of ultramarine. Stein's papers were characterised as interesting both to chemists and physicists, inasmuch as they contain tolerably cogent reasoning in favour of an unusual view of the chemical composition of ultramarine, and as they refer the well-known colour of that body to causes previously known to physicists but probably never recognised as present in it. To prepare the way for a discussion of Stein's views, the author of the paper briefly summarised the leading steps in the manufacture of green and blue ultramarine, and then proceeded to state the general character of the discussions that have from time to time taken place during the last forty years respecting the composition of blue ultramarine specially. The supposition that the sulphur is combined only with sodium was said to be a general characteristic of these discussions. The various views enunciated by different investigators were said to differ from each other on two points:—(1) Which sulphur-acids are combined with sodium? (2) The mode in which silica is combined with alumina and soda. Of these views two were referred to as having been the subject of research about twelve years ago in the Giessen laboratory under the direction of Professor Will, and the decision in favour of one of them was stated to have had, in all probability, some influence in arresting further discussion until the appearance last year of Stein's papers.

In the account given of Stein's researches the author expressed his belief that the facts adduced by Stein disproved the generally entertained views as to the presence either of polysulphide of sodium, or of monosulphide and hyposulphite of sodium in blue ultramarine. The arguments advanced to show that sulphide of sodium cannot be the cause of the blue colour were briefly referred to, and the hypothesis that the colour is due to the presence of small molecules of black sulphide of aluminium enclosed in correspondingly small and thin envelopes of a double silicate of soda and alumina was stated as being the essential point in Stein's views. The author shortly criticised the said hypothesis, and, while considering it as worthy of serious attention at the hands of chemists and physicists, expressed his impression respecting the want of evidence with respect to the state—free or combined—in which the sulphide of aluminium exists. The paper concluded with an account of a subsequent research of Stein's in which it is proved to the satisfaction of the author, that in cobalt-ultramarine the oxide of cobalt present is one of the oxides of that metal known to be *per se* a black neutral body. This fact is adduced by Stein to show that, in all probability, cobalt-ultramarine owes its blue colour to its having a physical structure similar to that attributed by him to ordinary ultramarine.

The President, in opening the discussion, said Mr. Dixon's paper had the charm of novelty about it, but he was not prepared to admit the truth of the hypothesis advanced by Stein regarding the colour of ultramarine.

Dr. Clark suggested that the colour was possibly due to the existence in ultramarine of some of the blue variety of sulphur which is sometimes found when that element is precipitated in very minute subdivision.

Mr. Patterson referred to Tyndall's experiments on light, and stated that Dr. Clark's blue sulphur was probably only another illustration, along with ultramarine, of the effect of exceeding fine division of certain varieties of matter reflecting only blue rays.

Mr. Sutherland, in order to show that Stein's hypothesis was not satisfactory in respect of the coating of silicate of alumina and soda spoken of by Mr. Dixon, inasmuch as while boiling caustic soda dissolves alkaline silicates, that is no effect on ultramarine.

CORRESPONDENCE.

WATER ANALYSIS.

To the Editor of the Chemical News.

Sir,—I desire to express my gratitude to Mr. Nicholson for so candidly withdrawing his adverse statement respecting the ammonia process. Others, besides Mr. Nicholson, have, before now, reported unfavourably, but he alone has made an honourable retreat.

Some of those who formerly reported against the process are sometimes described as the most distinguished chemists in this country. Dr. Frankland, for instance, who described himself, officially, as unable to make it work. (Does he use Government apparatus? Possibly he does, and possibly his having also discovered five abortive methods of generating hydrogen is to be set down to that score). Dr. Odling, who joined Dr. Frankland in the report to the Government against the

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ammonia process, appears to have retreated from his position—satisfactorily, however, I cannot say—inasmuch as whilst practically admitting the validity of our method by working it in his laboratory, he has refrained from withdrawing his share of the conjoint condemnation which he and Dr. Frankland furnished to Government. I think it right, from time to time, to call attention to facts of this description, in order that the rising generation of chemists may know what to expect from those who at present occupy prominent positions in this country.—I am, &c.,

J. ALFRED WANKLYN,

London, March 16, 1872.

MISCELLANEOUS.

Atmospheric Poisoning of Houses by Arsenical Wall Coverings.—There is one question closely connected with the sanitary condition of dwelling-houses, which has hitherto been unaccountably neglected by those in charge of the public health, and that is, How are our walls covered? With paper, paint, and distemper wash, containing the deadly and volatile poison of arsenic, which is continually giving off poison in the form of an impalpable dust, and also of arseniuretted hydrogen, which is gaseous at the usual temperature of the air. The fact that nearly all the green colouring now in use is arsenical has been indisputably proved by eminent analysts. Specimens can be produced of pale green papers containing 6, 9, and even 14 grs. of arsenic to the square foot, and papers containing only a leaf or line of green in the pattern are arsenical and injurious. Yet such papers are to be seen everywhere; in royal palaces, in the mansions of our nobles and gentry, in lodging houses, and in the homes of the middle and industrial classes in town and country. Medical men have these poisonous papers on their walls, and suffer from them unawares. Arsenic was first employed in the manufacture of wall-papers about the beginning of this century, and its use has been on the increase year after year up to the present time. If we cover our walls with a poison which is not only deadily but volatile, can we wonder at deterioration of health and of race? The writer's experience of the danger of arsenical wall-papers extends over a period of fourteen years, during which an entire household, numbering fourteen persons, suffered severely. Many physicians were consulted, but the symptoms baffled them all. The writer's eyes were at last opened by reading "The Green of the Period" (Routledge), and analysis proved that every paper in the house which contained a speck of green was arsenical: these were at once removed, and a Turkish bath put up in the house, by using which daily, symptoms threatening fatal results were quickly relieved. But now follows an important point, proving that arsenic is not confined to green colouring as supposed, but is used in papers of all colours, and even in white. Our papers containing green were replaced with others totally devoid of green, but in a few months' time many alarming symptoms reappeared. Suspecting arsenic again, all these papers were analysed, and arsenic was found in the paper of every bedroom in the house, though not one contained even a speck of green. On removing these papers, and colouring the walls with whiting and size, tinted with safe colours, relief soon followed, and health has since steadily improved. (Further details are given in two articles contributed to the *British Medical Journal*). It often happens that dangerous arsenic papers are concealed underneath harmless ones, owing to the pernicious custom of putting one paper over another. A very severe case of poisoning by this means has recently come under my notice. Many of the pigments now in use appear to contain arsenic; therefore, in substituting paint or wash for paper, it is important to know of what the colours are composed. There is a "new blue" used for colouring walls, which contains arsenic, and the green distemper wash so often used instead of paint is almost invariably arsenical; being totally unglazed, it is all the more rapidly injurious. But the gaseous exhalations of arsenic have been found dangerous, both from glazed papers and oil paint, as was proved at Munich in 1860. The Prussian Government, recognising the danger, "forbid the use of arsenic in any colours, whether distemper or oil, for indoor work." Yet in this country arsenic paint is freely used on the walls of our rooms, and on Venetian blinds; the green paint used for these latter articles containing about 75 per cent of arsenic. Of what use, comparatively speaking, are restrictions on the sale of arsenic by druggists, when painters and paper-makers can purchase it in unlimited quantities, using it by tons weekly for wall-papers, and thus poisoning the population wholesale? Legislation in this matter is urgently called for, to make penal the use of arsenic in any form in the interiors of houses, and to provide legal protection and compensation for the victims of this iniquitous mode of poisoning, the existence of which, unchecked, is a disgrace to our Government. There is also another question to be dealt with—How to get rid of all the arsenic now on our walls, which, without doubt, is permanently injuring the health of the present and rising generation, and through them future generations? How can anything but deterioration of race result from living, and bringing up children, in atmospheres where every breath that is drawn conveys a deadly poison into the blood? The cerebral symptoms produced by arsenic are peculiarly deserving of attention, and offer a wide field for investigation to physicians who devote themselves to the study of diseases of the brain and nervous system. Fevers and eruptive diseases appear to result not unfrequently from this mode of blood-poisoning, and who can say how much of epidemic disease and mortality therefrom may not be in a great measure due to this cause, by predisposing the system for its reception, and by the prostration of strength which would tend to induce fatal results in attacks not of themselves dangerous. I would conclude by drawing special attention to the bearing of the whole subject on the expected visitation of cholera; one marked effect of arsenic being to produce choleraic diarrhœa and other symptoms akin to that disease.—*Abstract from the "Transactions" of the Social Science Association*, 1871.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, March 4, 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral subjects:—

Absorption Spectra of Chlorine and of Chloride of Iodine.—D. Gernez.

Crystallised or Burnt Iron.—H. Caron.—This essay contains the detailed account of the results of a series of experiments made with malleable iron of good quality, for the purpose of ascertaining the effects of very high temperatures upon that metal for the purpose of obtaining burnt iron, and to detect what the precise change is which is thus produced; it also contains the results of experiments at very low temperatures in order to produce the crystalline state of iron, and to see whether such iron is or is not more liable to fracture. It appears from the author's researches that, as regards burnt iron, it is produced as much by exposing the metal to very high temperatures in oxidising, as in reducing and quite inert, atmospheres; and that

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deterioration of the metal appears to be due not to the absorption of any particular gas, but to the action of the heat, which modifies its molecular constitution. As regards the action of great cold (some of the bar iron has been kept for more than four consecutive months at temperatures varying from 0° to −18° and −20° in the frigorific works of Ch. Tellier at Auteuil), none of the iron bars had become crystalline, and their resistance to breaking force as well as other properties were unimpaired.

Acetic Ethers of Dulcite.—G. Bouchardat.—In this lengthy memoir we find the detailed description of the mode of preparation and the properties of the following bodies:—Diacetic dulcite, a solid, crystalline, insipid, and inodorous substance; fusing at 176°; volatile, without leaving a carbonaceous residue, when heated in small quantity at a time upon platinum foil; soluble in tepid water, slightly soluble in alcohol, and insoluble in ether; formula—

$$C_{20}H_{16}O_{16}=C_{12}H_{14}O_{12}+2C_2H_4O_2-2C_2H_6O_2,C_{20}H_{16}O_{16}=$$
$$=C_{12}H_{14}O_{12}+2C_4H_4O_4-2H_2O_2.$$

Diacetic dulcitane, at the ordinary temperature an oily liquid; soluble in water, alcohol, and ether; formula—

$$C_{20}H_{16}O_{14}=C_{12}H_{14}O_{12}+2C_4H_4O_4-3H_2O_2.$$

Hexacetic dulcite, a solid crystalline substance, fusing at 171°; difficultly soluble in boiling water, but readily so in hot alcohol; formula—

$$C_{36}H_{38}O_{24}=C_{12}H_{14}O_{12}+6C_4H_4O_4-6H_2O_2.$$

Tetracetic dulcitane, a solid resin-like substance; almost insoluble in cold water, but very soluble in alcohol and ether; formula, $C_{28}H_{30}O_{18}=C_{12}H_{14}O_{12}+4C_4H_4O_4-5H_2O_2$. Pentaceto-monochlorhydric dulcite, an instable crystalline compound. Pentacetic dulcite; the properties of this body are nearly the same as those of the hexacetic dulcite. Acetic acid and dulcite form a large number of neutral compounds, which may be formulated in the following general manner:—$C_{12}H_{14}O_{12}+nC_4H_4O_4-nH_2O_2$ (n can assume in this case any value between 1 and 6), and $C_{12}H_{14}O_{12}+mC_4H_4O_4-(m+1)H_2O_2$ (m can assume for the dulcitane series any value between 1 and 5).

Bromhydrates and Chlorhydrates of Allylen.—Dr. Reboul.—Allylen unites at the ordinary temperature with a very concentrated aqueous solution of bromhydric acid, the result being the formation of dibromhydrate of allylen, a heavy oily liquid, boiling at between 114° and 115°; sp. gr. at 10°=1·875; empiric formula, $C_3H_4,2HBr$; constitutional formula—

$$\begin{matrix}CH_2\\CBr_2\\CH_3\end{matrix}$$

The monobromhydrate of allylen is likewise a liquid, boiling at from 48° to 49°; sp. gr. at 9°=1·39; treated with bromine, this substance is converted into a dibromide—

$$\begin{matrix}CH_2\\CBr_2\\CH_2Br\end{matrix}$$

Allylen also directly unites with hydrochloric acid, whereby two chlorhydrates of allylen are formed, the dichlorhydrate predominating; this latter, when separated by distillation, boils at about from 69° to 70°, and appears to be identical with Dr. Friedel's methyl-chloracetol.

Pyruvine.—Dr. Schlagdenhauffen.—This short paper, as yet only a preliminary notice, contains the intelligence that the author has discovered a glyceride of pyro-uvic acid, by heating glycerine with tartaric acid at a rather high temperature. Analysis proves this body to be composed according to the formula—

$$\left.\begin{matrix}C_3H_5\\H_2\\C_3H_3O_3\end{matrix}\right\}O_2,$$

that is to say, pyruvine, a solid crystalline body, fusing at 78°; soluble in alcohol, ether, sulphide of carbon, benzine, and especially in chloroform; water dissolves, but at the same time decomposes, it; pyruvine boils at 242°.

Origin of the Aurora Borealis.—Dr. E. H. von Baumhauer.—The author calls attention in this paper to what was published by him in the year 1844 on this subject (in his dissertation "De Ortu Lapidum Meteoricarum," Utrecht, 1844, of which an abstract appeared in 1845 in Poggendorff's *Annalen*, vol. lxv., p. 465); his opinion on the probable origin of the aurora may have been left unnoticed at the time, but has not, at any rate, been controverted on sound scientific grounds, and is well worthy the attention of all interested in this matter.

Reciprocal Action of Acids and Alkaline Bases Separated from each other by a Porous Septum.—E. Landrin.—Notwithstanding the high scientific value of this paper, its contents, elucidated by tabulated forms exhibiting the results of experiments, are not suited for useful abstraction.

Nitrogen Determination in Organic Substances.—L. Kessler.—While adopting the well-known method of Dumas, which the author thinks to be preferable to Will and Varrentrapp's, he substitutes for the graduated glass jar placed over mercury, and intended to collect therein the nitrogen, a caoutchouc bag, wherein some caustic soda solution is first poured, and which is next hermetically connected with the combustion-tube, the bag being kept under water during the time the combustion proceeds; when that operation is finished, the bag is emptied under water, the gas it contains being collected in a graduated glass jar.

Annalen der Physik und Chemie, von Dr. J. C. Poggendorff, No. 12, 1871.

This number contains the following original memoirs and papers *relating to chemistry* and collateral sciences:—

Spectra of some Gases as Exhibited in Geissler Tubes.—A. Wüllner.—The continuation and concluding portion of a very lengthy monograph, the contents of which, notwithstanding its very high scientific value, are not suited for abstraction, an observation equally applying to the two following memoirs:—

Law of the Formation of the Lichtenberg Figures.—W. Bezold.

Influence of Astronomical Motion upon Optical Phenomena.—E. Ketteler.

Mineralogical Communications.—G. vom Rath.—Tenth instalment and end of this exhaustive mineralogico-crystallographical monograph, illustrated by a series of engravings.

Mode of Distribution of Electricity over the Discs of Holtz's Electrical Machine, and on an Advantageous Modification in the Construction of the same.—T. Schwedoff.—The contents of this essay could not be understood unless the engravings belonging thereto were reproduced.

Decrease of the Chemical Force of Hydrogen and Carbonic Oxide for the Reduction of Proto-Peroxide of Iron by the Admixture of Foreign or other Gases.—W. Müller.—The contents of this memoir bear on the essays published by Dr. Sainte-Claire Deville some two years ago in the *Comptes Rendus*; the main results of the author's researches may be summarised as follows:—A mixture of iron and of proto-peroxide of that metal, when heated in an atmosphere of steam and hydrogen or of carbonic acid and carbonic oxide, calls forth a constant ratio of the gases which is not afterwards altered by the same (viz., the solid substances); the reaction of the gases which do not chemically combine as far as can be proved, is a molecular general phenomenon; the action of different other gases, mixed also with those named, does not simply depend upon their specific gravity, but is also dependent upon, and changed by, the nature of these gases.

Use of Permanganate of Potassa in the Galvanic Battery.—J. H. Koosen.—This lengthy paper contains the record of a series of experiments made for the purpose of testing the applicability of permanganate of potassa solution and the dry salt for exciting galvanic currents; it appears that this salt may be used very advantageously for this purpose, yielding galvanic currents of great strength and durability.

Sounding Flames.—H. Planeth.

Determination of the Horizontal Components of Terrestrial Magnetism by Chemical Means.—Dr. H. Schneebeli.

Electrical Tourbillon.—W. Grüel.—The description of an instrument contrived to exhibit the rotation phenomenon first discovered by Dr. Holtz.

No. 1, 1872.

The original papers and memoirs contained in this number nearly all strictly bear upon mathematico-physical science rather than upon chemistry; we give the translation of the titles of these memoirs—

Essay on the Theory of the Electro-Double Machine.—Dr. J. C. Poggendorff.

Reflection Prism.—J. B. Listing.

Anomalous Dispersion.—A. Kundt.

Essay to Explain the Anomalous Dispersion of Colours.—O. E. Meyer.

Propagation (Fortpflanzung) of Light.—J. J. Muller.

Contribution to the Mechanical Theory of Heat.—R. Clausius.

Experiments made for the Purpose of Determining the Coefficients of Expansion of Metallic Wires at Unequal Degrees of Tension.—G. R. Dahllander.

Algebraico-Crystallographical Essay on some of the Double Salts of the Acetate of Uranium.—Dr. C. Rammelsberg.—Illustrated with woodcuts.

Absorption Rays of Chlorophyll.—L. Schönn.

Chromate of Baryta.—E. Zettnow.—The author describes some salts of chromium and baryta formed by the action of sulphuric acid upon chromate of baryta. One of these salts was found on analysis to give results leading to the formula $BaO,2CrO_3,2HO_2$; in 100 parts, after deducting 1·35 per cent of hygroscopic moisture—Baryta, 39·35; chromic acid, 51·26; water, 9·25. The other salt was found to be pure bichromate of baryta.

Tetronerythrin, a New Organic Pigment.—Dr. Wurm.—A statement was made in 1868 in the *Wiener Jagdzeitung* to the effect that the red warty spot met with above the eyes of the mountain-cock and moor-cock (*Tetrao tetrix*), when rubbed with a white handkerchief, imparted thereto a beautiful red colour. The author was inclined to disbelieve this, and accordingly made some microscopical and microchemical researches on this subject, the result being that he discovered a pigment which he terms tetronerythrin (from *Tetraon* and *erythros*, mountain-cock red). A very small quantity of this pigment, which is soluble in chloroform, was sent by the author to Dr. J. von Liebig, who states that it is a peculiar substance which has nothing in common with the colouring matter of the blood; it is soluble in ether and sulphide of carbon, not soluble in cold caustic alkaline solutions, and soluble in hot nitric acid, but decomposed simultaneously, leaving a waxy residue.

Observations of Double (Extra) Rainbows.—Dr. G. Schneider.—Illustrated by woodcuts.

Annales des Mines, No. 5, 1871.

This number contains the continuation and end of the very lengthy and exhaustive monograph—

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Metallurgy of Silver in Mexico.—P. Laur.—Illustrated by several engraved plates. It appears that the only impediment to a very extensive working of the literally inexhaustible mineral wealth of this large and beautiful country is civil war raging there almost uninterruptedly.

Use of Quick-Lime in Blast-Furnaces, and on the Preparation of it in Hoffmann's Annular Furnace.—L. Gruner.—Illustrated by engravings.

Industry of Bituminous Schists (Slate) of the Autun Basin.—M. Chosson.—This exhaustive monograph, illustrated by a series of engraved plates, contains very valuable information concerning the best methods of utilising bituminous slates, and the preparation of valuable products (paraffin, paraffin oil, lubricating oil, &c.) therefrom.

Les Mondes, February 29, 1872.

Cheap Oxygen; Ammonia Prepared from the Nitrogen of the Air.—Rev. F. Moigno.—The excellent author first briefly refers to a paper published in the CHEMICAL NEWS of Feb. 23 last, "On the Utilisation of Waste Substances in Gas Liquor," by R. F. Smith, and then states that the cyanide of titanium there alluded to will become shortly a substance of great industrial importance, inasmuch as this substance will be used in Tessié du Motay's process, after withdrawing oxygen from the air by means of manganate of soda, to fix the nitrogen of the air, and next to convert this into ammonia by passing hydrogen over it; it appears that the experiments made in this direction have been very successful.

Hydrozincite Discovered at Aronzo (Peru).—Dr. Cossa.—The author states that the deposits of calamine (a zinc ore) at the locality alluded to are often found covered by a white earthy-looking material, which the miners throw away as useless rubbish; on analysing this mineral the author found it to be a pure hydrated carbonate of zinc, a mineral first discovered (or at least recognised as a peculiar mineral) in 1803 by Smithson, who named it hydrozincite; the mineral here alluded to was found on analysis to lead to the formula—

$$3CO_3+8ZnO+6H_2O.$$

March 7, 1872.

Programme of the Prize Essays of the Royal Belgian Academy of Sciences for 1873.—Among the various subjects the following chemical question occurs:—New researches to be made for the purpose of obtaining knowledge on the composition of, as well as on the mutual relation existing between, the albuminoid substances; a gold medal of the value of £24; the essays to be legibly written in Latin, French, or Flemish languages, and to be sent on or before June 1 next, carriage or postage paid, to M. Ad. Quetelet, the Perpetual Secretary of the Academy at Brussels. For 1874—New experiments on uric acid and its derivatives, chiefly for the purpose of settling their chemical structure and synthesis.

Usual Nomenclature of 550 Textile Fibres, and the Indication whence and from what Plants they are Derived, their Use, &c., by Bernardin.—Under the title here translated, the author has edited a work which, according to the review here published, contains a very large amount of very useful information, the more so as it appears that the number of textile fibres actually employed in arts and industry is exceedingly limited as compared with those met with in nature and industrially available.

Secchi's Metereograph.—Rev. Father F. Fauva, S.J.—The author, writing from Manilla, states that the instrument alluded to has been during the last two years employed by him at the observatory of the city alluded to, and has given, in every respect, excellent results.

Importance of Declivity in Arboriculture; Hooibrenk's System.—Dr. Duchesne-Toureau.—The first portion of a memoir, illustrated with woodcuts, which curiously verifies for plants what used to be in former ages often applied in animal physiology, "Ubi stimulus ibi affluxus;" the system, simple as it is, deserves attention on account of its really splendid practical results, also in respect of the hitherto unknown or unnoticed power of man over the vegetable kingdom.

Polytechnisches Journal von Dr. E. M. Dingler, first number for February, 1872.

This number contains the following original and papers memoirs relating to chemistry and collateral sciences:—

Improved Diffusion Apparatus for Obtaining Beet-Root Juice.—E. Robert.—Illustrated by engravings.

Potash Industry at Stassfurt.—T. Becker.—The contents of this exhaustive memoir, elucidated by a series of tabulated forms exhibiting the density and boiling-point of various saline solutions, &c., give a very complete description of the very important industry alluded to.

Application of Sulphur in the Roasting of Silver Ores in the Stetefeldt Furnace.—G. Küstel.—A metallurgical paper, recording the results of some experiments made on the large scale with a peculiarly constructed furnace, previously described and elucidated in the above-named periodical.

Chloralum and its Preparations Considered as Disinfectants.—Dr. A. Fleck.—This paper contains the results of analyses and researches on this subject.

The American Journal of Science and Arts, February, 1872.

This number does not contain any original papers relating to chemistry.

Le Moniteur Scientifique Quesneville, No. 362, February, 1872.

The only original paper relating to physico-chemical science published in this number is—

Studies on Dupuy de Lôme's Air-Balloon.—W. de Fonvielle.—A lengthy essay on this subject.

Revue Universelle des Mines, de la Métallurgie, des Travaux Publics des Sciences et des Arts Appliquées à l'Industrie, No. 5, 1871.

This number does not contain any original papers relating to chemistry, but we call attention to the following very important memoir:—

The Coal Formation of the South of Russia; its Situation, Industrial Importance, and Geologico-Geognostic Bearing.—A. Erbreich.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 229, January, 1872.

This number does not contain any original papers relating to chemistry, but we call attention to the following:—

Report made by M. Tresca on the Hydraulic Apparatus Employed in the Gaité Theatre for the Purpose of Moving and Displacing the Various Portions of the Scenery, as Devised by M. Quéruel.—Illustrated by engravings.

La Revue Scientifique de la France et de l'Etranger, March 2, 1872.

This number does not contain any original papers relating to chemistry, but we mention the titles of the following important memoirs:—

History of the Armies and Arms of War.—Colonel Usquin.—The introduction of a series of very interesting lectures on this subject.

Animal Heat, the Temperature of the Blood, and the Vitalist Theories.—Dr. C. Bernard.

Artificial Production of Organic Calcareous Substances.—Dr. P. Harting.—This paper is illustrated by woodcuts. The eminent *savant* states that the contents of this paper are only a brief summary of a work about to be published by him under the title "Recherches de Morphologie Synthétique sur la Production Artificielle de quelques Formations Calcaires Organiques." Were it not for the necessity of reproducing the excellently executed woodcuts added to this paper, we would have given here a more detailed account of its contents.

Journal für Gasbeleuchtung und Wasserversorgung, No. 2, 1872.

The contents of this number bear strictly upon subjects relating to gas- and water-works' engineering and management.

NOTES AND QUERIES.

Fractional Distillations.—(Reply to H. D.)—Place the bulb a certain distance below the surface of the liquid.

Artificial Pumice.—(Reply to T. D.)—It is probable that either the spodumen-like material often met with in large quantity among the blast-furnace slag is meant, or a similar substance occurring in the worn-out crucibles (pots) of glass-houses.

Colour of Chlorine Gas.—It is usually stated in evening lectures that the colour of chlorine gas is not very distinctly observed by artificial light. If the light of burning magnesium is used, and a piece of white paper placed behind the gas as usual, its greenish colour is very evident.—G. C.

Prussian-Blue and Bichromate of Potash.—(Reply to "Ignoramus")—There exist, according to the different modes of preparation, various modifications of prussian-blue, of which the so-called basic variety is soluble in pure water after the salts with which, owing to its preparation, it is mixed up, have been washed out. It is prepared by carefully adding to an aqueous solution of so-called yellow prussiate of potash (ferrocyanide of potassium) a solution of pure protosulphate of iron, care being taken not to decompose all the ferrocyanide. The bluish-white precipitate thus obtained having been collected, is first exposed on a shallow vessel to the oxidising action of the air, and next thoroughly washed with distilled water until the latter begins to run off blue-coloured, thus proving that all the foreign salts are washed out, and the residue is then soluble in pure water. As to bichromate, some is made in France and Germany, but the great bulk in Scotland.

MEETINGS FOR THE WEEK.

MONDAY, March 25th.—Medical, 8.
—— London Institution, 4. Prof. John Ella, "On Elementary Music."
—— Royal Geographical, 8.30.
TUESDAY, 26th.—Civil Engineers, 8.
THURSDAY, 28th.—London Institution, 7.30. Musical Lecture.
—— Philosophical Club, 6.
SATURDAY, 30th.—Chemical, 8. Anniversary.

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TO CORRESPONDENTS.

G. C.—The paper was set up from a printed proof; any corrections should, therefore, come from the author.

R. B. W.—The English edition of Wagner's "Chemical Technology," which will shortly be published, will contain an excellent article on the manufacture of chlorate of potash.

R. G.—Our Reports on the quality of gas in London are official, and as far as we know, no fuller ones are published.

R. R.—Morfit's "Treatise on Soaps," published by Trübner and Co., will meet your requirements.

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THE CHEMICAL NEWS.

Vol. XXV. No. 644.

A BILL TO AMEND THE LAW RELATING TO PUBLIC HEALTH.

We have wished long and earnestly to see the present vague and inefficient sanitary laws amended, simplified, and brought into some kind of harmony with the chemical and physiological science of the nineteenth century. We have all along maintained that those manufacturing operations upon which our national prosperity depends might be so carried on as not to prove injurious to national health. We believe that nuisances—be they gaseous, liquid, or solid—might be arrested, not merely without loss, but even with advantage, to their present originators. It was, therefore, with deep interest that we took up this long-promised Bill. We regret to own that, after a careful perusal, we found ourselves disappointed.

In section 33 of the Bill we find a string of regulations, already unfavourably known to the scientific and the sanitary world as the "recommendations of the Rivers' Pollution Commissioners." We cannot say that long acquaintance has rendered them at all less unaccountable. We would ask Mr. Stansfeld and his chemical inspirers on what principle the numerical limits for the various impurities have been adopted? Why, for instance, should 0·03 of "organic nitrogen" be considered as objectionable as 2·00 of "organic carbon?" "Organic nitrogen" is, indeed, a peculiar object of dread; its sanitary equivalent—if we may use the expression—being fixed lower than that of arsenic itself. We are to be permitted to pour into any stream, however small, an unlimited quantity of a liquid containing, in 100,000 parts of water, anything less than 0·05 of metallic arsenic, or 0·066 of the ordinary white arsenic of commerce. Half the quantity of "organic nitrogen" is penal. Why should all metals except calcium, magnesium, potassium, and sodium, be excluded if they exceed 2 parts in 100,000? What is the objection to strontium? Are there no natural springs which contain iron and aluminium in even larger proportions. Why are barium, chromium, lead, and copper, all well-known and formidable poisons, permissible in any amount below 2 parts in 100,000 of water? We have heard it wickedly suggested that any very stringent enactment against lead and copper might act as a veto upon the notorious project for forcing a water supply from the metalliferous regions of Cumberland upon the metropolis.

Again, some nitrogenous organic bodies, such as albumen and gelatine, enter readily into decomposition, and yield products highly offensive. Others, also nitrogenous, are much more permanent, and, even if decomposed, yield no products injurious to public health: we may instance urea. Now to group under one head two bodies so utterly dissimilar in their sanitary bearings as urea and albumen merely because they both contain nitrogen is to violate the fundamental laws of scientific classification. No less illogical is the phrase "organic carbon." It is, indeed, high time that such expressions should be expunged from all sanitary discussions. To adopt and perpetuate them in official documents and Acts of Parliament is a reproach to modern science no less than a misfortune to the nation.

This 33rd clause terminates with a proviso charmingly vague and bewildering.

The Local Government Board to be constituted under the Act may "alter any of the foregoing conditions relating to pollution of liquids by *diminishing their stringency*," and may, even, if they think proper, "add to, or alter such conditions of *increasing* the stringency," provided that such proposed increase shall have been previously submitted to both Houses of Parliament for the space of forty days—a longer time of incubation than is required even for the egg of a goose! What the ultimate state of the law will be after a few of these increases and diminutions of stringency, neither man, angel, nor even Rivers' Pollution Commissioner can foretell.

Turning from sins of commission to those of omission—in which latter the Bill, to do it justice, is equally rich—we notice with regret that the air we breathe is not to be more thoroughly protected from pollution by offensive gases and vapours. A Public Health Act worthy of the name would extend to nitrous vapours, to sulphurous acid, to fluorine, &c., regulations similar to those which the Alkali Act applied to the escape of gaseous hydrochloric acid.

Clause 36 embodies the ordinary penalty of forty shillings on the emission of an exorbitant amount of black smoke. But even perfect combustion of coal would remove but a very small part of the evil resulting from its use. What is needed is to restrict the consumption of coal to the lowest practicable amount. Some manufacturers use three times as much coal to obtain a given amount of steam-power as do others in the same district. Here the law should interfere, and ascertaining what is the minimum amount of fuel consumed per horse-power produced, impose penalties on all excess of this standard. Thus we might hope to see a reduction in the amount of sulphurous acid which now withers up our fields, corrodes our public edifices, and irritates our lungs.

We shall watch the progress of this Bill with interest, but we fear that no probable amendments will convert it into a sound and creditable measure.

THE DECOMPOSITION OF WATER BY ZINC IN CONJUNCTION WITH A MORE NEGATIVE METAL.*

By J. H. GLADSTONE, Ph.D., F.R.S., and ALFRED TRIBE, F.C.S.

Pure zinc is incapable of decomposing pure water, even at 100° C., but at a considerably higher temperature it is known to combine with its oxygen. Davy exposed pure water for two days to the action of a pile of silver and zinc plates, separated only by pasteboard, without obtaining any hydrogen; Buff, however, had shown that a very minute trace of gas can be formed at the ordinary temperature by a pair of zinc and platinum plates.

During a series of experiments, of which we have already published an instalment, it occurred to us to ascertain whether by bringing the two metals closer together, and so increasing the electrical tension of the liquid, we could effect the same combination of zinc with oxygen, at the ordinary temperature, which takes place without the second metal at a very high temperature. Thin sheets of zinc and copper were hammered together and placed in a bottle filled with distilled water. Small bubbles of gas were formed. The experiment, however, was tried in a more perfect form. Some zinc-foil was allowed to remain in a somewhat dilute solution of copper sulphate until its surface was well covered with spongy copper. The metals were thoroughly washed with distilled water, and then they were immersed in a bottle of distilled water with a delivery-tube. Minute bubbles of gas quickly made their appearance, which proved to be hydrogen, and zinc-oxide was formed. Two experiments were made quantitatively, the gas being collected and measured at the end of twenty-four or forty-eight hours. The quantity of gas in cubic centimetres is given in the third and fourth columns of the subjoined Table, corrected for temperature and pressure. The mean temperature in

* Read before the Royal Society.

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the second column is simply the mean of the maximum and minimum during the period. In experiment A, 33·4 grms. of zinc-foil were employed, being 2·6 metres long, and 0·05 wide. The coils were kept apart by muslin. In experiment B there was used 1 metre of similar foil crumpled up.

Day.	Mean Temp. °C.	Expt. A. c.c.	Expt. B. c.c.
1.	12·8	117·1	49·6
2.	12·2	93·8	37·5
3.	11·7	73·8	27·6
4.	11·1	66·2	24·7
5, 6.	10·0	49·3 (×2)	17·5 (×2)
7.	8·9	41·1	14·9
8.	10·5	40·9	15·8
9.	10·0	40·9	14·8
10.	7·8	33·8	10·3
11.	6·7	28·0	9·4
12, 13.	6·1	21·9 (×2)	7·7 (×2)
14.	6·1	20·1	7·6
15.	7·2	31·1	10·3
16.	10·0	30·0	10·2
17.	8·3	29·4	8·5
18.	6·7	20·0	7·6
19, 20.	6·1	17·2 (×2)	5·7 (×2)
21.	4·4	20·0	6·6
22.	5·0	15·3	4·8
Interval.			
44.	10·0	20·5	5·5
45, 46.	10·5	22·5 (×2)	6·5 (×2)
47.	11·1	22·3	6·5
48.	11·1	24·1	8·1
49.	11·1	20·5	7·4
Interval.			
82.	10·0	18·0	4·7
83.	10·0	18·9	6·1
84.	10·0	14·0	5·1

The two experiments have evidently gone on almost *pari passu* for months, the amount of hydrogen evolved gradually diminishing, but showing, at the same time, a certain dependence on the heat of the day.

Under the microscope the bubbles of gas are seen to form, not on the zinc, but among the copper crystals, and sometimes to make their appearance on the glass at some distance off.

From the position of platinum in the electro-chemical series, we anticipated that the effect would be still more marked with that metal in a spongy state on the zinc. It was deposited from the tetrachloride, and, of course, thoroughly washed. There was only 0·6 metre of foil, but the following quantities of hydrogen were obtained:—

Day.	Mean Temp. °C.	Vol. in c.c.
1.	11·7	143·6
2.	11·4	93·6
3, 4.	10·0	38·8 (×2)
5.	8·6	26·0
6.	10·8	21·0
7.	9·4	17·1
8.	7·7	12·3

The first action, therefore, was about five times as great as in the case of the copper, and it diminished more rapidly; doubtless through the zinc becoming more quickly protected by oxide.

Lest it might be contended that the free oxygen usually present in distilled water had been the means of starting this action, the experiment was repeated with water as free from oxygen as could be obtained by boiling. One metre of the same zinc-foil, covered with copper, was employed, and the result was nearly as before, 40 c.c. of gas being obtained the first day at the mean temperature of 9° C. This arrangement was taken advantage of to examine the effect of a high temperature. Without removing the delivery-tube, the contents of the flask were heated to near 100° C., when 123·5 c.c. of hydrogen were given off in ten minutes. The apparatus was allowed to cool, with the mouth of the tube under water, when the production of gas became small again, and, after two days it was again heated nearly to the boiling-point, when it gave off 93·4 c.c. in ten minutes; after another period of two days it gave 64·1 c.c.; and after three days more 132·1 c.c. in the first thirty minutes, 108·4 in the second thirty minutes, 94·3 in the third, and 89·9 in the fourth.

Iron and lead, under similar circumstances, also decomposed pure water, and the action of magnesium was greatly increased by conjunction with copper. The effect of the more negative metal was the same as would have been produced by an increase of heat.

In a practical point of view this experiment may serve as a ready means of preparing pure hydrogen; in a theoretical point of view, its interest seems to lie in the fact that the dissociation of a binary compound by means of two metals may take place at infinitesimally short distances, when it would not take place were the layer of liquid enough to offer resistance to the current, and also in the correlation between this force and heat.*

ON COMETARY PHENOMENA.

By Professor W. A. NORTON.

In the *College Courant* of the 17th inst., under the head of the "Phenomena of Comets," quotations were made from a recent communication to the Chemical News by Professor Osborne Reynolds, containing allusions to certain investigations of mine on Donati's comet. The author represents me as having reached the result that the repulsive force exerted by the sun on cometic matter, urging it away from the head of the comet to form the luminous train, is "equal to from 0·75 to 0·55, the attraction of the sun for ordinary matter." This is an erroneous statement, and gives no adequate idea of the results actually obtained in the discussion referred to. My investigations on Donati's comet were undertaken with the view of subjecting the hypothesis of a solar repulsion of cometic matter, first propounded by Olbers, and ably maintained by Bessel, to a rigorous numerical test, by comparing quantitative theoretical determinations with the results of astronomical observation and measurement. For this purpose a long series of elaborate calculations were entered into, and detailed comparisons made with the actual comet as astronomically observed and measured. The following points were established by the discussion:—

(1). The preceding half of the tail of the comet was composed of matter repelled from the sun with a force varying in intensity with the different particles between the limits 0 and 1·5 (the force of gravitation being taken as the unit; the 0 line of particles differing but little from the middle line of the length of the tail, and the 1·5 line being its convex outline.

(2). The following half of the train was made up of matter subject to a diminished solar attraction varying between the limits 0 and 0·6; the latter obtaining along the concave outline.

These were the results upon the assumption that the particles left the head of the comet without lateral velocity. It was found that small initial lateral velocities might be assumed, and a train of nearly the same position, form, and dimensions, theoretically calculated, provided the above limits for the two sides of the tail were reduced from 1·5 and 0·6 to 1·213 and 0·455.

(3). It followed from the above results that the solar repulsion operated upon certain different portions of the matter expelled, with unequal intensities, in some instances exceeding the force of gravitation, and in others being of a less intensity; and that while the effective force

* Since the above was written we have accidentally heard that Dr. W. Russell has been working in the same direction.

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in operation varied between the limits just given, the actual repulsion varied between the limits 0·4 and 2·5; or if initial lateral velocities obtained, between 0·55 and 2·21.

(4). All the unequally repelled particles that set out at the same instant were found, at the end of any assumed interval of time, situated upon a right line traversing the tail obliquely, and which, if prolonged backwards, would pass nearly through the head of the comet. It followed from this that the matter expelled on several successive days would be found, at the end of that number of days, disposed in divergent bands lying in directions radiating out from the head of the comet, or nearly so. These bands should, however, form one continuous luminous mass, if the previous emission of the cometic matter had been the same from day to day, or had varied steadily and by slow degrees. This was, in fact, the ordinary appearance presented by the tail of the comet, but on certain evenings it was seen by Professor Bond and other observers, to have, at a distance from the nucleus, a "columnar structure," or to be arranged in an "alternation of bright streaks with intermediate darkness." These streaks, which were about ½° in breadth, conformed in their direction to the bands of particles previously emitted at successive intervals of a day, or thereabouts. We may infer, therefore, that the evolution from the head of the comet, of the matter that was urged away by the solar repulsion to form the train, was for a time periodically intermittent.

Professor Reynolds intimates that I did not suggest any explanation of the straight secondary tails, or streamers. This is a mistake. In a brief abstract of the principal memoir, published at an earlier date, it was stated to be one result of the discussion that these "were but lines of receding particles subject to much greater forces of repulsion than the other particles ejected from the nucleus." Two nearly straight narrow streamers were seen, on certain evenings, extending out from the convex side of the tail. They had the directions of lines of simultaneously ejected particles, and probably consisted of some more subtile nebulous matter, for which the varying repulsive action of the sun ran up to a very much higher limit than 1·5.

The sun is undoubtedly the great agent in the production of cometary phenomena; and he must act in two ways, for portions of the cometic matter are first brought by some solar agency into the condition to be repelled, which must then be repelled to great distances by the same or some other solar agency. Since the sun's force of repulsion varies in the inverse ratio of the square of the distance, and all the known forces received from the sun are propagated by ethereal waves, we infer that this repulsion is, in all probability, some form of wave-force emanating from the sun. If so, unless we have recourse to hypothetical agencies, we must conclude that the force in question is either a heat-repulsion or an electric repulsion. Our author's hypothesis, that it is of electric origin, is not a new one. It is open to the serious objection that electricity cannot experimentally be made to traverse a vacuum. It is true that this experimental result may be due to electrical conditions which do not exist at the surface of the sun's photosphere; and it is also true that the hypothesis that the electric ether pervades all space, furnishes a direct solution of the mysterious electric and magnetic sympathy existing between the sun and the earth, and thus has a certain air of probability. The necessity of this hypothesis cannot, however, be admitted, since the sympathetic communication between these cosmical bodies may subsist through the intervention of the luminiferous ether. If this electrical hypothesis should be conceded, the conditions through which heat may be conceived to evolve the cometary phenomena would also subsist with regard to electricity, and it would be difficult to decide between these two agencies. The electric theory of the phenomena of comets, and of certain apparently cognate terrestrial and solar phenomena, I have discussed in different communications to the *American Journal of Science*, without, however, finally adopting it. While deeming it probable that electricity may play a certain part in the diverse processes of transformation through which the head of a comet passes, under the varying influence of the sun, I have taken the ground, in my later papers, that the solar heat is the principal agent in the production of cometary phenomena. The sun's heat may determine that condition of the cometic matter in which it becomes subject to a repulsive action from the sun, either by dissociating the molecules or atoms, and so diminishing their power of absorbing heat, or by producing this effect directly without dissociation. For it is to be observed, that it is only that portion of the solar heat which is not absorbed by the molecules, or atoms, that can be effective in any degree as an impulsive force. The inequality of the sun's repulsion for different portions of matter expelled may be ascribed to inequalities in the size of the atoms of different vapours exposed to the wave force—the smaller atoms taking the higher velocities—or to unequal absorptive powers for heat of different atoms or molecules.

The theory of an universal force of repulsion (due to insensible and sensible heat), operating at all distances beyond the recognised limit of the attraction of cohesion of the molecules of ordinary bodies of matter, I have urged in different papers published in the *American Journal of Science*—maintaining that it is the determining cause of the conditions and phenomena of the contact of bodies, whether by statical pressure or by impact (in which in general no evidence is perceived of a sphere of attractive action being passed through before the repulsion comes into operation); that it constitutes the elastic pressure of gases; that as a force of cosmical repulsion taking effect upon highly attenuated vapours, with small atomic weights, it is the great agent in the wonderful processes of change through which cometary bodies are seen to pass, and at the sun's surface in urging upward, with a high velocity and to great heights, the incandescent masses of hydrogen that are seen as "red protuberances" on the edge of the solar disk in total eclipses, and in expelling to much greater distances the still more subtile vapour recognised by spectroscopists as forming the substance of the solar corona.

Sheffield Scientific School, New Haven., Conn.,
February 27, 1872.

NOTES IN SUPPORT OF THE ALLEGED ALKALINITY OF CARBONATE OF LIME.*

By WILLIAM SKEY,
Government Analyst, New Zealand.

In a paper of mine which appeared in the second volume of the *Transactions of the Wellington Philosophical Society*, I asserted the alkalinity of carbonate of lime, but the correctness of this assertion having been disputed by Mr. Charles R. C. Tichborne, F.C.S., M.R.I.A., &c., of the Laboratory of the Apothecaries Hall, Ireland, in a communication to the editor of the CHEMICAL NEWS (vol. xxii., p. 150), I have re-investigated this subject, and extended my researches upon it, by which I have arrived at results corroborative of the correctness of my statement, and which show, besides, that a large number of salts hitherto maintained to be neutral, or respecting which nothing has been affirmed, are in reality alkaline.

The latter results I will communicate here at any early date in a separate form, limiting this paper to an attempt to clear the ground already broken as far as I am able from the objections above referred to.

Mr. Tichborne very courteously, and with a considerable amount of plausibility, argues that "as the reddened

* Read before the Wellington Philosophical Society, September 30th, 1871.

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litmus which I used has the acid used to colour it only weakly combined with the tinctorial matter of the paper, the carbonate of calcium merely acts by abstracting this acid, and thus the litmus is brought back to its normal colour, blue with a shade of violet, and therefore this is not a reliable test in such a case."

In answer to this I would ask, Does not the capacity of the lime-salt to abstract the acid, whether acetic or carbonic (for I guarded against encumbering the process with a double decomposition by using the latter acid), argue most forcibly and sufficiently for its alkalinity?

If it does not demonstrate alkalinity in such a case, then reddened litmus, in opposition to all received opinion on this head, is not a proper, nor, indeed, a test at all, for ascertaining this character for *any* substance. I would ask, what other condition or property is required for a substance besides that enabling it to act as an alkali upon litmus, wanting which it is neutral?

However, I will not press this point further, as I do not wish to rely upon one set of experiments or upon any particular method I have adopted in them for testing the truth of my allegation. I have therefore availed myself of the use of the first test suggested by Mr. Tichborne for determining the question finally, and the results of this I will now describe.

Blue litmus paper, after being well washed in distilled water free from ammonia till of a pale violet colour, had its colour very distinctly changed to a deep blue on being pressed while moist upon a freshly fractured surface of calcspar. The failure of Mr. Tichborne to obtain a like result under the conditions he named I can only explain upon the supposition that a sufficient area of contact was not ensured between the spar and the paper to make the result a visible one.

In regard to Mr. Tichborne's second test, I take exception to the employment of *turmeric* paper in such a case as this, as it only shows alkalinity where it exists to a marked extent, and this is not a question of *degree*, but one of *condition*—alkalinity or neutrality.

That turmeric paper cannot indicate alkalinity where this does not reach to a certain intensity is manifest from the refusal of the organic base, aniline, to affect it, though it acts both upon the juice of red cabbage and reddened litmus as a body having alkaline characters, which character we uniformly accord it.

Again, pure strychnia I find, though not able to affect turmeric, behaves with reddened litmus like an alkaline body, which it certainly is; and this, by the way, may be the character or behaviour of the alkaloids generally with such tests.

Lastly, to anticipate a little of what I am leaving over, hydrous tribasic phosphate of lime does not colour turmeric, although, we are sure, from the manner in which it may be produced, and the circumstances attending its formation, that it must be alkaline—which character it plainly manifests to reddened litmus.

Thus, we can mix alkaline solutions of chloride of calcium and tribasic phosphate of soda, and the precipitate of phosphate of lime which falls leaves the supernatant solution distinctly *acid*. Now as we have no reason for supposing that the phosphoric acid in changing bases has lost any portion of its combining or neutralising power, we are constrained to hold that the precipitate thus resulting is (as this litmus demonstrates) alkaline—alkaline at least to an extent equally divergent from neutrality, as is the acid solution around it—and still turmeric gives no sign.

The turmeric paper test being, therefore, obviously unreliable for the detection of alkalinity in many cases, I rely for the verification of the correctness of the statement in question upon the results of the first test suggested in this criticism.

I have to apologise for having allowed such a length of time to elapse ere noticing these objections of Mr. Tichborne, but I waited thus in the hope that some one else might have taken up the question with such authority and potency of argument that would have sufficed to settle it one way or the other, and thus saved me further thought upon it, as it is so much more pleasant and exhilarating—besides being more in accordance with our colonial instincts—to break up fresh ground or explore new country than to turn back from this to tinkering about old work or to protect it from hostile blasts, even though these be ever so courteously blown or kindly tempered.

I will only add, I shall be very pleased to have this subject still further discussed, especially as it now appears likely that some general principle may soon be recognised, by the use of which we can easily and certainly classify into the three distinctive groups—acidic, basic, and neutral—those bodies whose reaction with test-paper is difficult to observe by reason of their intense colour or their extreme insolubility in water.

THE SPECIFIC GRAVITY OF OILS AND THEIR CO-EFFICIENT OF EXPANSION.

By C. M. STILLWELL, A.M.

THE sp. gr. of oils as determined by oleometers is liable to inaccuracy from imperfect instruments. I am accustomed, in testing oils, to reject the use of the oleometer, and to determine the sp. gr. by finding the weight of a known volume of the oil, and calculating its sp. gr. with reference to water at 15° C. The sp. gr. varies very much with increase of temperature. In order to reduce the found sp. gr. to the sp. gr. at 15° C., it is necessary to know the co-efficient of expansion of oil.

For the determination I use a 50 c.c. flask.

It is necessary, first, to very carefully determine the weight of boiled distilled water which the flask contains at 15° C. This having been determined, we next find the weight of 50 c.c. of the oil under examination, and the temperature at which this is taken. Then, the weight of oil, divided by the weight of water at 15° C., will give the sp. gr. of the oil at the observed temperature.

For example: 50 c.c. of castor-oil at 17·2° C., equalled 47·6487 grms. This, divided by the weight of 50 c.c. of water at 15° C., equalled 0·9654, that is, 0·9654 is the sp. gr. of the sample at 17·2° C.

The co-efficient of expansion is the difference in sp. gr. which corresponds to a difference in temperature of 1° C.

Suppose the sp. gr. of an oil is determined at 15° C., and is found to be 0·9162. The sp. gr. of the same oil determined at 20° C. is 0·9131. The difference, 0·0031, corresponds to an increase of 5° C.; that is, 0·00062 for 1° C. In the same way the co-efficient of expansion is determined with sp. gr. taken at different temperatures and the average taken. I have made such determinations, and the following are the average results of a large number of trials:—

Temp.		Co-ef. of Exp.
14·4° C. to 20° C.	=	0·000642
14·4° „ 25°	=	0·000641
15·0° „ 20°	=	0·000610
15·0° „ 25°	=	0·000625
Average		0·000629

or the co-efficient of expansion is 0·00063 for 1° C.

The oil selected for this determination was pure virgin olive oil.

In testing an oil by this method, it is best to make the determinations at a temperature as near 15° C. as possible.

We have then this rule: multiply the difference between 15° C., and x° C. by 0·00063, and add or subtract the product to or from the sp. gr. previously obtained, according as the temperature is above or below 15° C.

In the example above quoted, the sp. gr. of castor-oil is found to be 0·9654 at 17·2° C. To refer this to 15° C.

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we have: 17·2°−15°=2·2 × 0·00063 = 0·001386 ∴ 0·9654 +0·0013=0·9667=the sp. gr. at 15° C.

To clean flasks, test-tubes, &c., which have contained oil, I use the following method:—Let the oil drain off well; then put into the flask a little saponified red oil, or better, melt a little palm oil therein, and unite it with the oil by turning the flask around. The resulting mixture is very easily saponified by a hot caustic alkali. Every trace of oil can be removed by this treatment, which is far less expensive and troublesome than treatment with ether.

Commercial oils differ very much in sp. gr., although they may be classed under the same name. In the following table I give the results of my tests of the chief commercial oils. With but few exceptions, I procured the samples from first hands, and I believe them to be fair average samples of the oils sold.

TABLE OF SPECIFIC GRAVITY OF OILS.

Co-eff. of exp = 0·00063 for 1° C.

	15° C. 59° F.
Sperm, bleached, winter	0·8813
,, natural, winter	0·8815
Elaine	0·9011
Red, saponified	0·9016
Palm	0·9046
Tallow	0·9137
Neats-foot	0·9142
Rape-seed, white, winter	0·9144
Olive, light greenish yellow	0·9144
Olive, dark green	0·9145
Pea-nut	0·9154
Olive, virgin, very light yellow	0·9163
Rape-seed, dark yellow	0·9168
Olive, virgin, dark clear yellow	0·9169
Lard, winter	0·9175
Sea-elephant	0·9199
Tanners' (cod)	0·9205
Cotton-seed, raw	0·9224
Cotton-seed, refined, yellow	0·9230
Salad (cotton-seed)	0·9231
Labrador (cod)	0·9237
Poppy	0·9245
Seal, natural	0·9246
Cocoa-nut	0·9250
Whale, natural, winter	0·9254
Whale, bleached, winter	0·9258
Cod-liver, pure	0·9270
Seal, racked	0·9286
Cotton-seed, white, winter	0·9288
Straits (cod)	0·9290
Menhaden, dark	0·9292
Linseed, raw	0·9299
Bank (cod)	0·9320
Menhaden, light	0·9325
Porgy	0·9332
Linseed, boiled	0·9411
Castor, pure cold-pressed	0·9667
Rosin, third run	0·9887

—*American Chemist.*

ON SOME EXPERIMENTS WITH FEHLING'S COPPER SOLUTION.*

By T. L. PATTERSON, F.C.S.

The copper solutions used in the following experiments were prepared according to the instructions given by Fresenius. 34·632 grms. of sulphate of copper, dissolved in 200 c.c. of water, were added to a solution of 173 grms. of tartrate of soda and potash in 480 c.c. of soda solution of 1·14 sp. gr. or thereby, and the whole made up to 1 litre. They were tested with one of inverted sugar, prepared as follows:—0·5 grm. of pure dry loaf sugar free from glucose was dissolved in a small flask in 10 c.c. of water, 30 drops of HCl added, and a thermometer inserted. The flask, with its contents, was then placed in a water-bath for fifteen minutes, or until the thermometer indicated 70° C., when it was removed and diluted to 300 c.c. Each c.c. of this solution was thus equal to 0·001754 grm. of glucose.

The experiments were conducted in flasks, rather than basins or beakers; because, with the latter that portion above the liquid is liable to become over-heated to such an extent that, when the solution is stirred or shaken, part of it is likely to become reduced, and thus lead to erroneous results. Flasks are not liable to the same objection if they be occasionally shaken until they boil. When any portion is thus reduced the whole must be rejected.

Experiment 1.—(*a*). 10 c.c. of a copper solution were boiled with about 40 c.c. of water in a flask without precipitation. The standard sugar solution was then added from a burette graduated to ¼th c.c. until, on filtering off a portion rapidly, no copper-coloured precipitate was obtained on the addition of a few drops of acetic acid and one drop of a very dilute solution of ferrocyanide of potassium. 30 c.c. were thus consumed. Another experiment gave the same result, and 30 × 0·001754 = 0·05262 grm. of glucose, the amount required to reduce 10 c.c. of copper solution.

(*b*). 10 c.c. of the same solution were treated precisely as in (*a*), with the addition of 10 c.c. of soda solution of sp. gr. 1·163. It now required 33 c.c. of the sugar solution for complete reduction, which is equal to 0·05788 grm. of glucose.

(*c*). Other 10 c.c. were boiled with the addition of 50 c.c. of soda solution. When 34 c.c. of sugar solution had been consumed the cupric oxide was not all reduced; nor was reduction complete after the further addition of 14 c.c. in quantities of 2 c.c. at a time, testing after each addition. The result was the same when 50 c.c. were added to another portion of 10 c.c. in quantities of 5 c.c. after the 35th c.c.

The results of this experiment lead me to question the conclusions of Fehling, Fresenius, and others, who assume that 1 molecule of grape sugar reduces 10 molecules of cupric oxide. Had this been the case, 10 c.c. of the solution in (*a*) would have consumed 28·5 c.c. of the standard sugar solution, equal to 0·05 grm. of glucose, whereas 30 c.c. = 0·05262 grm. were required. (*b*) and (*c*) I believe show the reason of this, and prove satisfactorily that the quantity of cupric oxide reduced depends as well upon the alkalinity of the solution as on the amount of oxide of copper which it contains. Consequently, as the amount of soda varies, the solution's power of oxidising grape sugar will also vary, and must be determined for each solution separately. When, moreover, the soda is in great excess, as in (*c*), accurate results cannot be obtained.

Experiment 2.—With the view of showing the effect of soda on an old solution, the following experiments were made:—

(*d*). A copper solution, 10 c.c. of which were equal to 0·05262 grm. grape sugar, had been in occasional use for about five months. For some time soda had to be added to prevent precipitation. 10 c.c. were found to equal 0·039 grm. of glucose; but, with the addition of 40 c.c. or so of soda, 10 c.c. were equal to 0·05614 grm. of glucose.

(*e*). Another solution, having the same sugar-destroying power as (*d*), at the end of five months precipitated on boiling. 10 c.c. were equal to 0·04035 grm. of grape sugar. 10 c.c. + 10 c.c. of soda solution of 1·13 sp. gr., and 30 c.c. or so of water, did not precipitate on boiling, and consumed sugar solution equal to 0·05331 grm. of glucose; and 10 c.c. + an addition of 50 c.c. of soda solution required 0·05702 grm. of inverted sugar for complete reduction.

* Read before the Glasgow Philosophical Society, March 11, 1872.

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We learn from this experiment that soda renews an old solution, as is well known; but the alkali must be added sparingly—in fact, not more than is necessary to prevent precipitation on boiling, otherwise it will have too high a glucose-destroying power, and so give a low percentage of fruit sugar in any sample of sugar under examination. We see here also, as in Experiment 1, that the oxidising power of the cupric solution increases as the quantity of alkali increases; and so, by the addition of soda in excess, an old solution can be made to represent a greater amount of glucose than the same solution did when new!

The deterioration of copper solutions kept for some time, such as those in Experiment 2, has been variously attributed to the action of light, absorption of carbonic acid, &c. In Watts's "Dictionary," we are told to preserve the solution in well-closed vessels to protect it from CO_2 and air. But, even when so protected and kept in the dark, a solution in constant use still deteriorates. To what, then, is this deterioration due? I have always found, on removing the stopper from a cupric solution bottle which has not been opened for a few days, that a partial vacuum existed within, and the vacuum was the greater the longer the bottle remained closed. Clearly this vacuum is not due to the absorption of the small amount of CO_2 in the air of the bottle; it must, therefore, be owing to the absorption of oxygen: and this I find to be the case, for, on inserting a lighted splinter into a bottle half-filled with the solution, it is at once extinguished, nor can it be made to enter beyond the neck—a sufficient proof that the gas in the bottle is nitrogen.

Experiment 3.—To determine the amount of this absorption, whether it was partial or complete, the following experiment was made:—Into a tube closed at one end, containing 50 c.c., and graduated into $\frac{1}{4}$th c.c., I enclosed a quantity of dry air over mercury, which, after reduction to 0° C. and 760 m.m. pressure, measured 42·76 c.c. 4 c.c. of copper solution—10 c.c. of which equal 0·05175 grm. of glucose—were then introduced, and the whole set aside in diffuse daylight. The experiment lasted about 8 months. Absorption was slow and gradual, extending over a considerable period, but not so long as this experiment would lead one to believe. It was only allowed to stand so long, in order to be quite certain that absorption had ceased.

The copper solution in the tube had now a much lighter colour, and cupreous oxide was deposited on the sides for the space of about a c.c. where the mercury first came in contact with the solution. The reading of the tube, after making all the necessary corrections, was 34·09 c.c. at 0° C., and 760 m.m. barometer. Now, $42{\cdot}76 - 34{\cdot}09 = 8{\cdot}67$ c.c. oxygen absorbed by the 4 c.c. of copper solution, and $\frac{8{\cdot}67}{42{\cdot}76} \times 100 = 20{\cdot}28$ per cent of the original air. This agrees very well with the quantity of oxygen in the air, as determined by Bunsen, viz., 20·93 per cent, and shows that all the oxygen has been absorbed. The difference is due to experimental error; for instance, the barometer used was an aneroid, which always showed a slight variation when compared with a standard. The residual nitrogen was tested as before, but it would not support combustion.

The foregoing experiment shows satisfactorily the complete absorption of oxygen by the liquid; and in order to observe further the effect of oxidation and decomposition another experiment was made.

Experiment 4.—(*f*). The copper solution used in this experiment had a glucose-destroying power of 0·04965 grm. per 10 c.c. The CO_2 and Na_2O were estimated in separate portions of 10 c.c. each—the former in a CO_2 apparatus, and the latter by saturation with normal solution of H_2SO_4, boiling to expel CO_2, and backward titration with normal Na_2O solution. The Cu solution was thus found to contain 0·18 grm. of CO_2, and to have a neutralising power of 5·39 grm. Na_2O per 100 c.c.

Having been in almost daily use for a month, during which time it was kept in a cupboard, the solution was nearly finished. There was still no precipitation on boiling. 100 c.c. contained 0·30 grm. of CO_2, and had a neutralising power of 5·26 grms. Na_2O.

Two small bottles, (*g*) and (*h*), were half filled with solution (*f*), and securely stoppered. (*h*) was placed in the direct sun's rays, and (*g*) was rolled in paper and placed in a tin case, in order thoroughly to exclude light. After the lapse of eight months the bottles were opened and analysed.

(*g*). That bottle kept in the dark had not changed in depth of colour, no precipitate had formed, it remained perfectly clear on boiling, and contained 0·18 grm. of CO_2, with a neutralising power of 5·27 grm. of Na_2O per 100 c.c.

(*h*). The second bottle, exposed in the direct solar rays, was much lighter in colour, the stopper was with difficulty removed, and there was deposited at the bottom a copious crystalline precipitate of cupreous oxide. The solution filtered from this precipitate gave a second precipitate on boiling, and 10 c.c. were equal to 0·00087 grm. of glucose. It contained 0·33 grm. of CO_2, and had a neutralising power of 4·89 grms. of Na_2O per 100 c.c.

The injurious effect of light on this solution is very well seen in (*h*). Nearly all the Cu has been precipitated; while the solutions, (*f*) at the end of one month, and (*g*), are quite unaffected by boiling. (*h*) has also increased 0·15 grm. of CO_2, and decreased 0·5 grm. of Na_2O, in neutralising power per 100 c.c. Now this gain in CO_2 could not have been the result of absorption from the atmosphere, for the CO_2 had not increased in the bottle kept in the dark (*g*), and the partial vacuum in the bottle showed that the stopper was perfectly tight. Nor could it have been produced by oxidation, as the bottle in which the solution was contained held about 100 c.c., and was half-filled with the solution, the other half being air. 50 c.c. of air, weighing 0·0608 grm., and containing 0·014 grm. of O, are only equal to 0·01924 grm. of CO_2, whereas 0·075 grm., nearly four times that quantity, was found. Therefore the CO_2 found in this experiment is partially produced by oxidation, and partially the result of the decomposition of the tartaric acid promoted by the actinic rays.

The fixation of 0·50 grm. of Na_2O is conclusive on this point. The tartaric acid, under the influence of light and absorbed O, becomes split up in such a manner that its neutralising power is considerably increased in presence of the free alkali. We may suppose one molecule of the bibasic acid to decompose into one of another bibasic and one of a monobasic acid, besides CO_2, and so exert an extra-neutralising power on the Na_2O to that extent. I made no experiments to determine what acids these are, but they are likely to be related to oxalic, and contain less carbon than tartaric acid.

At the end of one month (*f*) had gained 0·12 grm. of CO_2, and lost in alkalinity 0·13 grm. of Na_2O. This decomposition is similar to that of (*h*), but, for want of time and exposure to light, has not proceeded to the same extent. From the fact, however, of this bottle being in constant use—not under precise conditions, but kept principally in the dark, though occasionally in the light—now open, and again closed—I will not hazard an opinion on the results.

The CO_2 in (*g*), the bottle kept in the dark, was the same at the end as at the commencement of the experiment; but the alkalinity of the solution had decreased to the extent of 0·12 grm. of Na_2O per 100 c.c. So that, although when kept in the dark in well-stoppered bottles the solution does not oxidise, yet it undergoes a slight internal decomposition, similar to that induced by light in (*h*), whereby the fixed acidity is increased in presence of the excess of alkali. Light is thus necessary for oxidation, and darkness retards decomposition; phenomena which I venture to assert are more general than at first sight might be supposed. With the exception of the decrease in alkali, the (*g*) solution may be said to be as good and sound as the original solution (*f*), proving that it can be preserved, under exceptional conditions, for a reasonable length of time (eight months in this case).

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In Experiment 2, (*d*) and (*e*), I have shown the deteriorating influence of age on solutions in constant use. For the purpose of these experiments my solutions have been kept in the dark; but I have been in the habit of using bottles for preserving the solution, made by the York Glass Company from a kind of dark green glass. These bottles cut off the actinic end of the spectrum as far as the green, and are useful for preserving HNO_3, silver and other salts, decomposed by light. To test the preservative qualities of this glass for the Cu solution, I made another experiment, as follows:—

Experiment 5.—One of the green bottles was half-filled with the solution and placed in the direct rays of the sun for six months. At the commencement of the experiment 10 c.c. were equal to 0·05179 grm. of grape sugar; at the end, 10 c.c. were equal to 0·05000 grm., and the solution when boiled showed no sign of precipitation. The result is thus in favour of these bottles; for with this severe test the solution has only lost the power of oxidising 0·00179 grm. of glucose, while that kept in a white glass bottle under the same circumstances (*h*) had nearly all its Cu precipitated.

Did Fehling's solution only deteriorate by the absorption of O, there might be inserted in the bottle a perforated cork, through which a tube passed holding fragments of pumice moistened with a strong solution of pyrogallate of potash. I have not tried this arrangement; but, as I have shown, in Experiment 4 (*g*) and (*h*), that decomposition takes place without the absorption of O, I do not think any useful purpose would be served by such an addition.

In conclusion, these experiments show—

(1). That Fehling's solution has no definite grape sugar equivalent depending upon the weight of cupric oxide it contains, but that its glucose-destroying power varies directly (within certain limits) with the quantity of alkali present; and that when Na_2O is in great excess all the Cu cannot be precipitated with a solution of inverted sugar.—Experiment 1, (*a*) (*b*) (*c*).

(2). That old solutions are renewed by an addition of Na_2O, as our text-books set forth; and, moreover, that by adding the alkali in considerable excess, the glucose-destroying power of the solution can be made to exceed that of the same solution when first prepared.—Experiment 2, (*d*) (*e*).

(3). That all the oxygen is absorbed by the solution from air in a confined space, as in a partially filled bottle. —Experiment 3.

(4). That, under the influence of light, decomposition is almost complete; and CO_2 increases to a greater extent than can be accounted for by the absorption of oxygen.—Experiment 4, (*h*).

(5). That the amount of Na_2O in the solution decreases with its age, even when kept in total darkness; and that this loss of alkalinity is to be attributed to the decomposition of the organic acid into other fixed acids, the total acidity of which is greater than that of the original tartaric acid.—Experiment 4, (*f*) (*g*) (*h*).

(6). That a solution kept for eight months away from light in a bottle containing air is in good condition at the end of that time.—Experiment 4, (*g*).

(7). That the solution is best kept for use in dark green bottles which exclude the actinic rays.—Experiment 5.

The President, after referring to the great scientific and practical interest of Mr. Patterson's paper, said that he had himself found the same results in his operations, although he had not prosecuted his inquiries as to the cause of those results to the same extent as the author of this paper. One thing he had observed was, the solution should be frequently renewed.

Mr. Sutherland referred to the action of carbonate of soda, and asked Mr. Patterson if he had tried it. He had found it useful in determining the amount of glucose in glycerine, and would like to know if there was any true glucose in ordinary sugar.

Mr. Patterson observed that he had not tried carbonate of soda in sugar testing, and that it was inverted sugar rather than true glucose that had to be determined. In reply to Mr. Tatlock, he observed that it was probable that the red precipitate found in the operations was due to the decomposition of tartaric acid.

ON THE

RELATIVE POWER OF VARIOUS SUBSTANCES IN PREVENTING PUTREFACTION AND THE DEVELOPMENT OF PROTOPLASMIC AND FUNGUS LIFE.*

By Dr. F. CRACE CALVERT, F.R.S.

To carry out this series of experiments, small test-tubes were thoroughly cleansed and heated to dull redness. Into each was placed 26 grms. of a solution of albumen containing 1 part of white of egg to 4 parts of pure distilled water, prepared as described in my paper on protoplasmic life. To this was added 1-1000th, or 0·026 grms., of each of the substances the action of which I desired to study.

The reasons why I employed 1 part in 1000 are twofold. First, the employment of larger proportions would, in some instances, have coagulated the albumen; secondly, it would have increased the difficulty of observing the relative powers of the most efficacious antiseptics in preventing the development of the germs of putrefaction or decay.

A drop was taken from each of the tubes, and examined under a microscope having a magnifying power of 800 diameters. This operation was repeated daily with the contents of each tube for thirty-nine days, and from time to time for eighty days. During this time, the tubes were kept in a room the temperature of which did not vary more than 3°, viz., from 12·5° C. to 15·5° C.

In order the better to show the influence of the antiseptics used, I examined two specimens of the same solution at the same time, one of which was kept in the laboratory, the other in the open air.

A marked difference was observed in the result; the one kept outside becoming impregnated with animal life in less than half the time required by the other, while as many vibrios were developed in six days in the tube kept outside as were developed in thirty days in the tube in the laboratory.

A summary of the results of the experiments is given in the following table, in which the substances are grouped according to their chemical nature:—

	Days required for Development of—	
	Fungi.	Vibrios.
1. *Standard Solutions.*		
Albumen kept in laboratory for comparison	18	12
Albumen exposed outside laboratory	None	5
2. *Acids.*		
Sulphurous acid	21	11
Sulphuric acid	9	9
Nitric acid	10	10
Arsenious acid	18	22
Acetic acid	9	30
Prussic acid	None	9
3. *Alkalies.*		
Caustic soda	18	24
Caustic potash	16	26
Caustic ammonia	20	24
Caustic lime	None	13

* Abstract of a Paper read before the Royal Society.

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	Days required for Development of—	
	Fungi.	Vibrios.
4. Chlorine Compounds.		
Solution of chlorine	22	7
Chloride of sodium	19	14
Chloride of calcium	18	7
Chloride of aluminium	21	10
Chloride of zinc	53	None
Bichloride of mercury	81	None
Chloride of lime	16	9
Chlorate of potash	19	17
5. Sulphur Compounds.		
Sulphate of lime	19	9
Protosulphate of iron	15	7
Bisulphite of lime	18	11
Hyposulphite of soda	18	11
6. Phosphates.		
Phosphate of soda	17	13
Phosphate of lime	22	7
7.		
Permanganate of potash ..	22	9
8. Tar Series.		
Carbolic acid	None	None
Cresylic acid	None	None
9. Sulphocarbolates.		
Sulphocarbolate of potash ..	17	18
Sulphocarbolate of soda ..	19	18
Sulphocarbolate of zinc	17	None
10.		
Sulphate of quinine	None	25
Picric acid	19	17
Pepper	None	8
Turpentine	42	14
11.		
Charcoal	21	9

In comparing the results described in the above Table, the substances can be classed under four distinct heads, viz:—those which prevent the development of protoplasmic and fungus life; those which prevent the production of vibrio life, but do not prevent the appearance of fungus life; those which permit the production of vibrio life, but prevent the appearance of fungus life; and those which do not prevent the appearance of either protoplasmic or fungus life.

The first class contains only two substances, carbolic and cresylic acids.

In the second class, also, there are only two compounds, chloride of zinc and bichloride of mercury.

In the third class there are five substances, lime, sulphate of quinine, pepper, turpentine, and prussic acid.

In the fourth class is included the remaining twenty-five substances.

The acids, while not preventing the production of vibrio life, have a marked tendency to promote the growth of fungus life. This is especially noticeable in the case of sulphuric and acetic acids.

Alkalies, on the contrary, are not favourable to the production of fungus life, but promote the development of vibrios.

The chlorides of zinc and mercury, while completely preventing the development of animalcules, do not entirely prevent fungus life, but I would call special attention to the interesting and unexpected results obtained in the cases of chlorine and bleaching-powder. When used in the proportion above stated they do not prevent the production of vibrio life. In order to do so they must be employed in excess; and I have ascertained, by a distinct series of experiments, that large quantities of bleaching-powder are necessary. I found that part of the carbon was converted into carbonic acid, and part of the nitrogen was liberated.

If, however, the bleaching-powder be not in excess, the animal matter will still readily enter into putrefaction. The assumption on which its employment as a disinfectant has been based, namely, that the affinity of the chlorine for hydrogen is so great as to destroy the germs, is erroneous.

The next class to which I would call attention is the tar series, where neither the carbolic nor the cresylic acid fluids gave any signs of vibrionic or fungus life during the whole eighty days during which the experimett were conducted.

The results obtained with sulphate of quinine, pepper, and turpentine, deserve notice. None of them prevent the development of vibrio life; but sulphate of quinine and pepper entirely prevent the appearance of fungi. This fact, together with the remarkable efficacy of sulphate of quinine in cases of intermittent fever, would lead to the supposition that this class of disease is due to the introduction into the system of fungus-germs; and this is rendered the more probable if we bear in mind that these fevers are prevalent only in low marshy situations, where vegetable decay abounds, and never appear to any extent in dry climates, even in the midst of dense populations, where ventilation is bad, and putrefaction is rife.

The results obtained in the case of charcoal show that it possesses no antiseptic properties, but that it prevents the emanation of putrid gases, owing to its extraordinary porosity, which condenses the gases, thus bringing them into contact with the oxygen of the atmosphere, which is simultaneously condensed.

The above results have been confirmed by a second series.

A series of experiments was also undertaken, substituting gelatine for albumen, and was continued for forty-seven days.

Vibrio appeared in two days in the standard gelatine solution, and bacteria after four or five; and during the whole time of the experiment, life was far more abundant than in the albumen solution. A distinct putrid smell was emitted after twenty-six days.

With bleaching-powder it took twenty days for life to appear, instead of seven, as in the case of albumen; while at no time during the twenty-nine days which remained was life abundant. No putrid odour was emitted; but a mouldy one could be detected on the thirtieth day.

With chlorine solution vibrio life was only observed after forty days; no putrid nor mouldy smell was given off at any time.

The protosulphate of iron gave, with this solution, results quite different from those with albumen, in which, it will be remembered, vibrios appeared in seven days, and fungi after fifteen: whilst, with gelatine, neither protoplasmic nor fungus life appeared during the time the experiments were continued.

Another substance, arsenious acid, also presented a marked difference in its action in the two solutions; for although with albumen twenty-two days elapsed before vibrios were present, and eighteen before fungi, with gelatine animal life appeared after two days, and at no time did any fungi exist. The effects of the other substances with gelatine were so similar to those with albumen that it is unnecessary to state them here.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 21st, 1872.

Dr. Odling, F.R.S., Vice-President, in the Chair.

After the minutes of the preceding meeting had been read and confirmed, and the donations announced, the following names were read for the first time:—Messrs. Thomas Tyrer, George Blundell Longstaff, John Robins,

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Thomas Roberts Ogilvie, Mark Finch, Arthur John Dickinson, and Frederick William. For the third time—Messrs. George Attwood, Edward Northway Butt, and William Moss Bouron, who were ballotted for and declared duly elected.

When the Chairman had announced that the Faraday lecture would be delivered by Professor Cannizzaro on Thursday, May 30th, the Secretary read a communication from M. Máumené of Paris, which latter stated that the hyponitrous acid discovered by Dr. Divers did not exist, the reaction between the compound NO_3H_2 (O=8) and silver nitrate being represented by the equation—

$$17NO_3H_2+4AgONO_5 = \\ =4AgO,NO+[4HO+4HONO_5]+13NO_3H_2,$$

since his hypothesis required $n = \frac{170}{40} = 4{\cdot}25 = \frac{17}{4}$, and concluded by saying that this was one of the numerous instances in which chemists had been led into error by the atomic theory.

From a question put by Dr. WILLIAMSON it appeared that M. Maumené's statements were not supported by any analyses or experiments.

Dr. DIVERS said that it would, perhaps, be better first to mention something in the history of the research in question. About two years ago M. Fremy published a paper in the *Comptes Rendus* on the reducing action of sodium on nitrites, and a fortnight afterwards a communication from Maumené appeared on the same subject giving better methods, and, at the close, a few lines stating that the action of strong sodium amalgam on nitrites gave ammonia as the principal product, whilst weak amalgam gave the compound NO_3H_2 (O=8), a substance possessed of strong reducing powers. Six months afterwards another paper of M. Fremy's was published, in which he acknowledged the help he had received from M. Maumené's researches, out found that oxyammonia was always produced during the reduction of nitrous acid. Subsequently to the publication of the paper in the *Proceedings of the Royal Society*, M. Maumené wrote and asked Dr. Divers very courteously whether he had not anticipated him; he allows the existence of the compound AgNO, but considers it to be a peculiar substance, and not silver hyponitrite. In regard to the equations in his communication to the Society, it must be remembered that he considers the doctrine of substitution of types, of ismorphism, &c., to be false, and a belief in them likely to lead to erroneous deductions, supposing that when the compounds NO_3H_2, and AgO,NO_5 (O=8) are mixed in solution, the number of atoms which come in contact are inversely proportional to their equivalents, so that in this case—

$$n = \frac{E}{e} = \frac{170}{40} = \frac{17}{4}$$

that is, 17 atoms of NO_3H_2 ($e=40$) come into contact with 4 atoms AgO,NO_5 (E=170), or within the sphere of each other's action, any excess being unacted on, whence his equation—

$$17NO_3H_2+4AgO,NO_5 = \\ 4AgO,NO+[4HO+4HONO_5]+13NO_3H_2.$$

One difficulty, however, is how NO_3H_2, which is a neutral compound possessed of no marked properties, can displace nitric acid.

Dr. ODLING remarked that we might as well leave out the extra $13NO_3H_2$ from each side of the equation.

Dr. DIVERS replied that in this case it would appear to be so, but in the case of copper and sulphuric acid, other compounds besides cupric sulphate and sulphurous anhydride were produced: in the action of chlorine on acetic acid only a certain definite proportion of the latter was converted into chloracetic acid; in the decomposition of lead oxalate by heat, the residue contained two equivalents of lead oxide to one of metallic lead: all these M. Maumené explained by his hypothesis. In the latter case he supposed the lead oxalate, PbO,C_2O_3, to become dissociated on being heated to 350°, and then one molecule of PbO acts on the three C_2O_3, giving rise to metallic lead, 4 of carbonic acid, and two of carbonic oxide, the decomposition taking place thus:—

$$3(PbO,C_2O_3) = 2PbO+Pb+4CO_2+4CO,$$

the residue containing metallic lead and lead oxide, and the evolved gases carbonic acid and carbonic oxide, in the proportions indicated. In the case of copper oxalate the decomposition was $2(CuO,C_2O_3) = Cu_2O+3CO_2+CO$, and the residue contains no metallic copper. M. Maumené professes to be able, by his hypothesis, to account for the difference in the decomposition in these two instances. It is possible that these may be merely coincidences, and that the speaker, when he had endeavoured to avail himself of this theory, had failed.

Dr. ODLING said that the Society was indebted to M. Maumené for this discussion, and especially to Dr. Divers for his kindly explanation of M. Maumené's views, and for the way in which he had upheld them although opposed to his own, but it must be considered that there are always at first a great number of exceptions to any new theory, which disappear on more accurate investigation. From reading Dr. Divers's paper, he considered he had satisfactorily established the existence of the hyponitrites.

Dr. DEBUS then made a communication to the Society. At the last meeting he had made some observations on the "reduction of ethylic oxalate by sodium amalgam," in which he explained he had been induced to undertake to disprove the existence of glycolinic acid by the theoretical consideration that in no organic compound did the number of molecules of hydroxyl, or, as he would prefer to call it, water residue, exceed the number of carbon atoms. Since then he had received a letter from Dr. Wright on this subject, to which he had not had time to reply, and thought the discussion of the apparent exceptions mentioned by him would be interesting to the Society. He desired, in the first place, to make some remarks on the difference between a molecular and an atomic compound. Ferrous sulphate combines with water, giving—

$$[FeSO_4+xH_2O].$$

Now if we attempt to replace the hydrogen in this compound by metals we cannot produce a compound of the same form, but in the case of sulphuric acid, H_2SO_4, the hydrogen can be replaced by metals, alcohol radicals, &c., and these compounds always have the same form as—

$$[H_2SO_4].$$

This is one great point of difference between molecular and atom compounds. Chloral, in contact with water, forms chloral hydrate, $C_2Cl_3HO+H_2O$, from which the water could be removed by treatment with sulphuric acid, and there is no chemical evidence to show that the H_2O is present otherwise than as water of crystallisation, so that even if chloral alcoholate had the composition—

$$CCl_3.CH.HO.EtO,$$

it would be no reason for assigning to chloral hydrate the composition $CCl_3.CH.HO.HO$.

Dr. WRIGHT replied that he could not see the difference between what Dr. Debus had termed molecular and atomic compounds, or why the water in crystallised sulphate of copper, for example, should be regarded as different from the water in calcium hydrate, as, in both instances, the water was separated on heating them. In the case of chloral hydrate and alcoholate they were both produced synthetically by similar methods, namely, by the union of chloral and water, or of chloral and alcohol, and since the latter, by the action of phosphoric chloride, was shown to have the composition $CCl_3,CH.(OH)(OEt)$ by analogy, we should consider chloral hydrate as $CCl_3.CH(OH)(OH)$.

Dr. WILLIAMSON said the discussion had branched off somewhat from the point from which it had started: what he understood Dr. Debus to mean was that no organic compound existed in which the number of atoms of hydroxyl was greater than the number of carbon atoms, and, as he had before mentioned, the fact that we had been unable to isolate the compound $CO_2(H_2O)$ was a strong confirmation of Dr. Debus's theory. He should himself prefer the terms physical and chemical, in order to dis-

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tinguish the compounds which Dr. Debus had designated as molecular and atomic; most chemists recognised the difference in the combined water, although there were instances, like chloral hydrate, which it would be difficult to class, some chemists being inclined to regard it in one light and some in another.

Dr. Debus, in reply to Dr. Wright, said that it was possible to explain the reaction between chloral alcoholate and phosphorous pentachloride on the supposition that the former had the constitution $CCl_3CHO+C_2H_5\}O$ ethylic chloride being first formed, which, acting on chloral as it is known to do on aldehyde would give—

$$CCl_3.CHO+C_2H_5Cl.$$

Dr. Odling remarked that he could not call to mind a compound consisting of carbon, hydrogen, and oxygen, in which the number of hydroxyl molecules exceeded those of the carbon; at the same time the difficulty which Dr. Wright had felt in making a distinction between atomic and molecular compounds had also been felt by many other chemists.

The meeting was then adjourned until Saturday, the 30th inst., when the Anniversary Meeting will be held. At the next ordinary meeting, Thursday, April 4th, Dr. Schorlemmer will give a lecture on "The Chemistry of the Hydrocarbons."

ROYAL DUBLIN SOCIETY.

March 18th, 1872.

Mr. John Wigham read a paper at the above Society, "*On the Use of Gas for Lighthouse Illumination.*"

The lecturer stated that coal gas was first used in lighthouses in 1865, by Mr. Samuel Bewley of the Irish Board of Lights, who tried some experiments at Howth. The first burner used was called the "crocus." The principles involved in this burner, and the means taken to economise the gas, proved that by the crocus there was an immense saving, taking light for light, as compared with the gas usually used in our houses. The lecturer then alluded to the economy as compared with oil. There was a saving of about £50 per annum on each lighthouse in which the gas had been tried, and, in the case of intermitting lights, the difference was much greater as regards economy. Dr. Tyndall had been sent down to investigate the whole matter at Howth, and that gentleman had reported favourably. There were five lighthouses at present on the Irish Coast illuminated by gas, and they are about to try it on two of the English lighthouses.

In speaking of the electric light, Mr. Wigham said, that though the latter was very intense, yet it was deficient in quantity, and it was not so good as coal gas for penetrating fogs. Mr. Wigham then proceeded to explain the mechanical arrangements and the construction of the lenses.

CORRESPONDENCE.

THE PRIESTLEY MEMORIAL.

To the Editor of the Chemical News.

Sir,—All who know what Priestley did for science will certainly acknowledge that they who are proposing to honour his name and commemorate his discoveries in a form that will be public and lasting are doing well; but there are many who will be asking whether the form that is proposed be precisely the best.

It is no other than a fact that we do not now in England possess any known sculptor who could give us a statue that would be really worthy or delightful; and, since one that would not be this could only be an excrescence and an eyesore, and would besides lack one attribute which certainly belongs to many of the uglinesses of Birmingham—the attribute of usefulness—why should not the Priestley memorial assume some other form?

Let Priestley's admirers, instead of a statue, set up a thoroughly well-appointed school of science, to be called "The Priestley Institution," or whatever other name be thought fitting. Science, much needed to supplement the technical skill employed in the industries of the Black Country, is not in that district so well provided for as to render the establishment of such a school unneedful. Or, if this undertaking be thought too vast, why not endow, at the Newcastle College or elsewhere, a scholarship of physical science to provide young aspirants from the Midland Counties with the opportunities of scientific practice and culture? The cost of such a scholarship would, I suppose, about equal that of a statue. Or, if this suggestion, again, do not find favour, nor that of a lectureship, surely the ingenuity of the committee can devise some scheme of a similar sort, so that thus the funds subscribed for this memorial are *used for science*, and not thrown away. I am sure there are many who would give their subscriptions all the more cheerfully if, instead of having to see as the result of them an absurd looking old gentleman standing for ever on a pedestal under a Birmingham sky, and making Birmingham more ugly than by man's art it already is, they could have the satisfaction of believing that they were helping to bring out and equip other Dr. Priestleys, or adding to the scanty educational resources of English science.—I am, &c.,

Chemicus.

Bury St. Edmunds,
March 21, 1872.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Neues Jahrbuch für Pharmacie, von Dr. F. Vorwerk (double number) November and December, 1871.

This number contains the following original papers and memoirs:—

Contribution to the History of Pharmacy.—Dr. J. B. Ullersperger.—This essay is in a measure original, but is based upon the contents of the book entitled "Storia della Farmacia e dei Farmaciati appo i Principali Popoli del Mondo," per Federigo Kernot; Napoli, 1871. It appears from the contents of this memoir that the work just quoted is a very important and well-digested volume.

Contribution to our Knowledge of the so-called False Cinchona Barks.—Dr. F. A. Flückiger.—A valuable pharmacognostical essay, from the contents of which it appears that the name of false (not genuine) has to be modified, inasmuch as certain barks—for instance, the *China alba Payta* and the *China cuprea*—contain the alkaloids of the genuine bark, while the anatomical appearance of the barks is similar to that of the really false (not containing quinine) barks.

Constituents met with in the Dried Cortex Nucum Juglandium.—Dr. T. Koller.—After first referring to the older researches on walnut shell (viz., the outer green shell or rind) of the common walnut, the fruit of the tree botanically known as *Juglans regia*, the author gives a very lengthy and detailed account of his experiments, treating the dried substance first with ether, whereby a quantity of 5·72 per cent of the substance was dissolved; a portion of this quantity was ascertained to be a tannic acid which yields with iron salts a green colour. The residue of the substance, after treatment with ether, was exhausted with alcohol, whereby a quantity amounting to 2·58 per cent was dissolved, chiefly consisting of chlorophyll. The residue, after treatment with alcohol, was digested with water, whereby 9 per cent of the substance was dissolved; starch was not found nor also sugar, but phosphoric acid was found in comparatively large quantity, while also a colouring matter was detected. The residue of this treatment was then first treated with hydrochloric acid, and next with a solution of caustic potassa (1 to 20); this latter solvent acted somewhat upon the pigment present in the rind, which colouring matter was, however, not completely dissolved until after a treatment with a solution of

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leaching-powder (1 to 8), when a nearly colourless residue of cellulose was obtained, and an amount of 52 per cent of pigment found to have been dissolved; no alkaloid was found, and, as regards mucine, this is no longer present in the dried rind.

Means of Distinguishing between Fruit and Grape Wine.—F. Vorwerk.—The main point of interest in this essay is that, according to the author's researches, the phosphoric acid present in genuine grape wine is combined with magnesia, while in fruit wines it is present in combination with lime. The simple addition, therefore, of ammonia 1 part to 9 parts of wine) will produce in genuine wine, after twelve hours' standing, the well-known precipitate of ammonio-phosphate of magnesia.

Contribution to the Chemistry and Physiology of the Agaricus Procerus.—A von Lösecke.—It appears that the sound and freshly-gathered eatable mushroom here alluded to emits, while exposed on a dish standing in a room, hydrocyanic acid in notable quantity, although after having been cooked this cryptogam is not poisonous.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, February 1, 1872.

Newly-Devised Water-Meter.—T. Sibon.—This paper contains very valuable information on water-meters in general, and on a new apparatus of the kind invented by the author.

Analysis of the Mud of the Harbours of Toulon and Rochefort.—Dr. Goussard de Mayolles.—The author analysed these substances with the view of testing their applicability as manures. The composition of the Toulon mud, the sample of which taken at 8 metres below sea-level, was found to be, in 100 parts—Water, 56·18; nitrogenous organic matter, 7·20; phosphate of lime, 6·55; phosphate of magnesia, trace; carbonate of lime, 5·80; carbonate of magnesia, 0·05; sulphate of lime, 2·64; sulphate of magnesia, trace; chloride of sodium, 1·34; alumina and oxide of iron, 0·90; nitrate of potassa, trace; silica and silicates, 19·31; total, 99·97. Rochefort mud, the sample being the uppermost layer of mud, in 100 parts—Water, 49·62; nitrogenous organic matter, 8·11; phosphate of lime, 5·75; phosphate of magnesia, 0·26; carbonate of lime, 8·48; carbonate of magnesia, 0·15; sulphate of lime, 4·12; sulphate of magnesia, 0·05; chloride of sodium, 0·88; alumina and oxide of iron, 1·14; nitrate of potassa, trace; silica and silicates, 11·08. Toulon is situated on the Mediterranean, and Rochefort is at the mouth of the river Charente, not far from the Atlantic Ocean.

Consumption of Gas by the Use of Different Burners and under Different Pressures.—E. Lemoine.—The continuation of an essay on this subject, this portion being illustrated by several woodcuts.

February 8, 1872.

This number does not contain any original papers on chemistry, but we call attention to a short paper, illustrated by a woodcut, and containing a description of a—

Two-Cylinder Steam-Engine with Expansion Gear, and so Constructed as to Require only 2 kilos. of Coal per Horse Power per hour, while at will the two cylinders can be used or only one.—M. Dubuc, C.E.

La Revue Scientifique de la France et de l'Etranger, March 9, 1872.

This number does not contain any original papers relating to chemistry, but we call attention to the following matters of interest:—

Continuation of the Lectures on the Organisation of Armies.—Colonel Usquin.

Physiological Experiments with Animals on the Mode of Action of the Brain.—Dr. Onimus.—Illustrated with woodcuts.

German University of Strasburg, Universitas Argentoratina.—This splendidly endowed institution will be opened on April 1st; as might be expected in a country where the motto "Knowledge is power" is, and has always been, the first requisite for further conquests, everything has been done to make the new university very effective, and the services of a large number of eminent men have been secured; among these we notice—Chemistry, Dr. Bayer; natural philosophy, Dr. Wundt; geology, Dr. Schimper; among the professors of the medical faculty we notice among others the names of Drs. Hoppe-Seyler, Lücke, Schmiedberg, &c.

Journal de Pharmacie et de Chimie, February, 1872.

This number does not contain any original papers relating to chemistry.

Zeitschrift für Chemie von Beilstein, No. 17, 1871.

This number contains the following original papers and memoirs:—

Chlorine Substitution-Products of the Ethylic Chloride.—W. Staedel.—After first referring to the researches of other scientific men on this subject, and reviewing what is precisely known on the very large number of the chlorine substitution-products of C_2H_6, the author describes dichlor-ethyl chloride, a liquid boiling at 74°; formula—

$$\begin{array}{l} C \\ CCl_2 \\ | \\ CH_2Cl \end{array}$$

and hichlor-ethyl chloride, also a liquid, heavier than water, colourless, smells like chloroform, and boils at 127·3°; with the discovery of this body all the chlorine substitution-products of the ethyl hydrogen *(Æthylwasserstoff)* which can possibly exist are found, and their composition determined, that of the last-named being—

$$\begin{array}{l} C \\ CCl_3 \\ | \\ CHCl_2 \end{array}$$

Dinitro-Phenols.—H. Hübner and W. Schneider.—In the introduction to this paper, the authors first refer to the researches of Laurent, Griess, Korner, Armstrong, and Schmitt on this subject, and next describe in catalogical manner a series of some twenty different compounds belonging to α series from ortho-nitro-phenol, α series from volatile nitro-phenol, β series from volatile nitro-phenol, and trinitro-phenol from α- and β-dinitro-phenol.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 4, 1872.

This number contains the following original papers and memoirs:—

Action of Pentachloride of Phosphorus upon some Aciamides.—Anna Wolkowff.—After first referring to her former researches on the action of chloride of benzoyl upon α and β sulpho-toluolamide, and reminding that the thereby obtained α and β benzoyl-sulpho-toluol-amides possess acid properties, yielding salts, $N(C_7H_7SO_3)(C_7H_5O)Mn$, the authoress describes the results of her researches on the action of pentachloride of phosphorus upon the aciamides (so the acids just mentioned have been termed by the authoress) formerly obtained by her. Benzoyl-sulphobenzol-aciamido-chloride, $N(C_6H_5SO_2)(C_7H_5)Cl$, a solid substance, soluble in ether, crystalline, and fusing at from 73° to 75°. Benzoyl-sulphotoluol-aciamido-chloride, $N(C_7H_7SO_2)(C_7H_5)Cl$, also a solid crystalline substance, soluble in ether, decomposed by boiling with water or weak alcohol, and converted into benzoyl-α-sulphotoluol-aciamide; when treated with a solution of carbonate of ammonia, the chloride is converted into the corresponding amide, $[N(C_7H_7SO_2)(C_7H_5)]NH_2$. Benzoyl-α-nitrosulphotoluol-aciamido-chloride, $N[(C_7H_6(NO_2)SO_2](C_7H_5)Cl$, akin to the foregoing, a solid crystalline body, difficultly soluble in boiling ether, and fusing at 125°. Benzoyl-sulpho-cymol-aciamido-chloride, $N(C_{10}H_{13}SO_2)(C_7H_5)Cl$, is a thick oily liquid, which attracts moisture from the air and is converted into a crystalline benzoyl-sulpho-cymol-aciamide. Benzoyl-α-sulphonaphthalin-aciamido-chloride, $N(C_{10}H_7SO_2)(C_7H_5)Cl$, a solid body, crystalline, soluble in ether, fuses at from 92° to 94°, decomposed by boiling water and alcohol, being thereby converted into the corresponding aciamide.

New Method of Decomposition of Rosaniline.—C. Liebermann.—In the introduction to this essay (which is as yet only to be considered as a preliminary notice, the researches not having been quite completed), the author first refers to the labours of Caro, Wanklyn, Fresenius, Dale, Schorlemmer, and Baeyer, on the probability of the existence of a connecting link between the constitution of rosaniline and of rosolic acid, and then states that it occurred to him that possibly water at a higher temperature might eliminate, from rosaniline, the imid group in the shape of ammonia. The author next records at length the results of his experiments in this direction. From these it appears that, at a temperature of from 270° to 280°, water, when acting upon fuchsine in a sealed tube, produces a body which is nearly free from nitrogen (1 per cent only of that element being left); water acting at 235° upon fuchsine produces a substance, $C_{20}H_{18}N_2O.OH_2$, a basic body which combines with platinum chloride.

Some of the Derivatives of Acetal.—A. Pinner.—This exhaustive memoir contains the record of the author's researches on the action of chlorine and bromine upon acetal, the bodies more particularly described being—Monobromacetal—

$$CH_2Br-\cdot-CH\begin{matrix}\diagup OC_2H_5 \\ \diagdown OC_2H_5\end{matrix}$$

a fluid heavier than water, insoluble therein; is decomposed by distillation, yielding hydrobromic acid; boils at 170°. Glycol-acetal—

$$CH_2(OH)-\cdot-CH\begin{matrix}\diagup OC_2H_5 \\ \diagdown OC_2H_5\end{matrix}$$

obtained by treating the foregoing compound with alcoholic potassa solution at from 160° to 180°; after purifying, it is a colourless liquid boiling at 167°; vapour density found = 66·61. Glycol-acetal ether—

$$CH_2(OC_2H_5)-\cdot-CH\begin{matrix}\diagup OC_2H_5 \\ \diagdown OC_2H_5\end{matrix}$$

a colourless, agreeably smelling fluid, boiling at 164° without decomposition; insoluble in, and specifically lighter than, water. Glyoxal-acetal, $CH(OC_2H_5)_2-\cdot-CH(OC_2H_5)_2$, a colourless liquid, insoluble in water, and boiling at 180°.

Some of the Derivatives of Chloral.—E. Hagemann.—This extensive essay contains a portion, as yet incomplete, of the author's researches on this subject; but we regret that, notwithstanding the great scientific merits of this paper, its contents are not suited for useful abstraction.

Freezing-Point of Aniline.—E. Lucius.—The author, one of the partners of the celebrated aniline makers and manufacturing chemists' firm of Meister, Lucius, and Brüning, at Höchst, near Frankfort-on-the-Maine, first states that it is generally said in works on chemistry that aniline remains fluid (unfrozen) even at −20°, and that this base is only solidified when exposed to the cold produced by a mixture of ether and solid carbonic acid; yet, during the past winter, a large carboy filled with aniline, and kept in the storehouse of the author's works, was found to be frozen, the cold never having been anything like so intense as to cause the thermometer to be as low as −20°. At first it was thought that the aniline in question contained

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some impurity, or toluidine; but, on being carefully tested, this turned out differently, and this sample of aniline (boiling at 182°—183°, sp. gr. at 17·5° = 1·024) was found to freeze again when cooled down to −8°; and the same result was obtained with several other samples of chemically pure aniline prepared in various ways—as, for instance, from isatine, hydrazobenzol, benzol, and also a sample of aniline (prepared in 1843) from coal-tar, but contaminated with the then unknown picoline. The author accounts for the seldom occurring, or at least observed, freezing of commercial aniline by the facts that, in the first place, it commonly contains fluid toluidine, and secondly, that, as found by him, it (the aniline, more or less pure) may be cooled down very much below −8° before solidifying, but then becomes instantly solid when touched with a solid body, the temperature rising at the same time to −8°.

Chlorated and Iodated Phenyl Oil of Mustard (Senföl).—Sima M. Losanitsch.—This memoir, elucidated by a series of lengthy and complex formulæ, is divided into the following sections:—Chlorphenyl-senföl; iodphenylsenfol.

Compound of Sodium with Glycerine.—E. A. Letts.—The author, formerly a student of King's College, London, gives an interesting and full account of his researches, made in the laboratory of Berlin University under the guidance of Dr. A. W. Hofmann, on the action of sodium upon glycerine, whereby the last-named substance is completely decomposed; but when sodium amalgam is made to act upon glycerine (best, however, by the intermediation of alcohol, sodium alcoholate, and without mercury), there is formed a solid compound, mono-sodium glycerate, a white, pulverulent, very deliquescent body, which may be heated up to 245° without fusing or decomposing, is decomposed by water into sodic hydrate and glycerine, and contains—Carbon, 31·5; hydrogen, 6·1; sodium, 20·1. The author further briefly alludes to his experiments made for the purpose of preparing a cyanogen compound of glycerine by passing chloride of cyanogen over the sodium glycerate alluded to; but respecting this and other researches more complete accounts will be given in the next number.

Bulletin Mensuel de la Société Chimique de Paris, July, August, and September (one number), 1871.

In addition to the *procès-verbaux* of the meetings of this Society held in November and December last, this number contains a series of papers, the contents of many of which, as also of the *procès-verbaux*, have been also published in other scientific periodicals and abstracted from these by us. We meet here, however, with the following original memoirs and papers:—

Researches on the Reciprocal Transformation of the Two Allotropic Conditions of Phosphorus.—G. Lemoine.—The complete and exhaustive memoir on this subject (see Chemical News, vol. xxiv., pp. 181 and 204), divided into the following sections:—General introduction; method of experimenting; transformation of red phosphorus; transformation of red phosphorus with the application of a condensing apparatus; experiment made for the purpose of obtaining the two inverse transformations; transformation of ordinary phosphorus; identity of limits by starting from (*en partant de*) the two allotropic conditions.

Oxide of Iron known as Forge-scales, and on the Protochloride of Copper Formed by the Combustion of Copper in Chlorine Gas.—M. Maumené.—The author states that, according to his theory, the composition of forge-scales is—

$$(FeO)_{20}(Fe_2O_3)_3 = Fe_{23}O_{47} = Fe_2O_{3\cdot71}.$$

As regards the protochloride of copper, it is stated that when Cu_2Cl is gradually formed in the presence of Cl, there is simultaneously produced an external layer of CuCl; and the two chlorides reacting upon each other, the result is the formation of a compound—

$$3CuCl + 2Cu_2Cl = Cu_7Cl_5.$$

Combinations of Sugar and Lime.—P. Horsin-Déon.—The contents of this very lengthy essay record the details of a series of researches on the subject alluded to; but, notwithstanding the great scientific value of this work, its contents are not well suited for any useful abstraction.

Quantitative Estimation of Very Small Quantities of Copper, and on the Presence of that Metal in Cacao Beans and in Chocolate.—E. Duclaux.—The copper is first precipitated from its acid solution by sulphuretted hydrogen, and this sulphuret, having been re-dissolved in a platinum crucible, is next reduced to the metallic state by means of zinc put into contact with the platinum. The author further states at great length that the platinum crucible employed in this operation becomes to some extent converted into an alloy of platinum and hydrogenium, whereby its weight is altered, and that, in order to counterbalance this effect, it is best to wash, after precipitation of the copper, the crucible with alcohol, next dry it at 100°, then ignite it strongly, and lastly weigh it with the copper, which is then removed by some nitric acid. The author has quantitatively tested some nineteen samples in all of cacao beans (*Theobroma cacao*) for the quantity of ash and copper therein contained, observing that, unless the incineration is very complete, the copper is retained tenaciously by the carbonaceous matter. As regards the quantity of copper in 1000 parts of ash, it varies, for cacao beans, from 0·009 to 0·040; for the outer shell (husks) of the same, for 1000 parts, from 0·035 to 0·225; for chocolate of various makers, for 1000 parts, from 0·005 to 0·125.

Preparation and Properties of the Oxide of Triethyl-Phosphine.—J. M. Crafts and R. D. Silva.—The contents of this very lengthy monograph, elucidated by a series of complex formulæ, are, notwithstanding the intrinsic merits, not well suited for any useful abstraction.

Les Mondes, March 14, 1872.

National Observatories.—Under this title we learn that by decree of March 5 last the President of the Republic has approved of the re-organisation of the Observatories of Paris and Marseilles, which, being independent from each other, have been re-constituted, so as to afford scope for astronomical and meteorological studies and observations, as well as physical geography.

Memoir on the Use of Secondary Electric Currents for the Purpose of either Transforming or Accumulating the Effects of a Galvanic Battery.—G. Planté.—Illustrated by woodcuts.

Dynamical Cold-Producing Machine (Réfrigérateur).—J. B. Toselli.—Illustrated with a woodcut. The description of a very ingeniously contrived machine for producing cold by the very rapid evaporation of water.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, December, 1871.

The only original paper relating to physico-chemical sciences contained in this number is an exhaustive memoir—

Caloric Spectrum of Sunlight and of Lime-Light.—Dr. S. Lamansky.

Journal für Gasbeleuchtung und Wasserversorgung, No. 3, 1872.

The contents of this number bear strictly upon subjects relating to gas- and water-works' engineering and management.

NOTES AND QUERIES.

Cement—Fractional Distillation.—Would any of your readers kindly oblige me with a receipt for cement to stop cracks in glass vessels, so as to resist moisture and heat? and also say where the most detailed information regarding the fractional distillation of coal naphtha is to be obtained?—C. S.

Steel Manufacture.—Can any reader state what class of manganese ores are preferred by still manufacturers: some ores are much more suitable than others. What foreign matters (if any) act beneficially, and what substances are to be avoided?—Early Subscriber.

BERNERS COLLEGE of CHEMISTRY.—EXPERIMENTAL MILITARY and NAVAL SCIENCES, under the direction of Professor E. V. GARDNER, F.E.S., &c.; of the late Royal Polytechnic Institution and the Royal Naval College.

The Laboratory and Class Rooms are open from 11 to 5 a.m., and and from 7 to 10 p.m. daily.

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Analyses, Assays, and Practical Investigations connected with Patents, &c., conducted.

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North London School of Chemistry, Pharmacy, &c.—For Instruction in Practical Chemistry and Evening Classes for the Study of Chemistry, Botany, Materia Medica, &c. Conducted by Mr. J. C. BRAITHWAITE, *for thirteen years Principal Instructor* in the Laboratories of the Pharmaceutical Society of Great Britain, and Demonstrator of Practical Pharmacy, Pharmaceutical Latin, &c.

Mr. Braithwaite, having taken the premises adjoining his house, has been enabled *nearly to double the size of his Laboratories*, and, at the same time, procure a large piece of ground which *he has had laid out as a Botanic garden*. Every facility is, therefore, offered to Students desirous of acquiring a practical knowledge of this branch of their education.

The Session 1871—1872 will commence on the 2nd of October, when the Laboratories will re-open at 10 a.m. for Instruction in Practical Chemistry as applied to Pharmacy, Medicine, Analysis, &c. Pupils can enter at any period. Terms moderate.

THE CHEMICAL and TOXICOLOGICAL CLASS will meet as usual every Monday and Thursday evening, commencing October 2nd, at 8 p.m.

The LATIN CLASS for the reading of Physicians' Prescriptions, Cæsar's Commentaries, &c., every Tuesday and Friday evening, commencing October 3rd, at 8 p.m.

The BOTANICAL and MATERIA MEDICA CLASS, every Wednesday and Saturday evening, commencing October 4th, at 8 p.m. The usual EXCURSIONS for the STUDY of PRACTICAL BOTANY will be continued every Saturday, until further notice, at 10 a.m.

Fee to either of the above Classes Half-a-Guinea per Month Pupils can enter at any period.

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THE CHEMICAL NEWS.

Vol. XXV. No. 645.

WATER ANALYSIS.

Four years have now elapsed since Dr. Frankland's method of water analysis was laid before the Chemical Society, and the time has now arrived for the chemists of this country to adopt a decided course in relation to it. As our readers are aware, Dr. Frankland undertakes to deal with the organic matter in drinking-water by burning it and then measuring the resulting nitrogen and carbonic acid. This combustion of organic matter in water differs from the ordinary organic analyses so universally practised by chemists in several important particulars. It is on a very much smaller scale,—instead of 2 or 3 decigrammes of substance, only about as many milligrammes of organic matter are subjected to analysis. Its difficulties are still further enhanced by the circumstance that more than a hundred thousand times as much water as there is organic substance has to be driven off by evaporation in the first stage of the process, and that a quantity of nitrates usually much exceeding the organic matter in amount has to be reduced. Still further to add to the difficulties of the undertaking, Dr. Frankland makes the determination of both carbonic acid and nitrogen in one operation, and not in separate operations as chemists are in the habit of doing.

Before assenting to the results arrived at by a process of this description, chemists required some proof that these great difficulties had been overcome, and were disappointed when they found that Dr. Frankland's experiments on dilute solutions artificially prepared and containing known quantities of various organic substances, exhibited an average error of 0·49 milligramme of "organic nitrogen" in a litre of water—a proportion of organic nitrogen far in excess of that which good drinking-waters contain. Under these circumstances it is not surprising that chemists should be almost unanimous in rejecting the results arrived at by Dr. Frankland's method of water analysis.

If this controversy had arisen in France there would have been a commission of the Academy to report on it. In this country we manage things differently, and resolve questions of this description after our own fashion, and we have to collect the testimony of competent scientific men who live and work in isolation. Mr. Way, who was formerly on the Rivers' Commission, has published his judgment on this question in a report on the analysis of a sample of water. It is to the effect that he uses and has confidence in the rival process of Wanklyn and his colleagues, which, it is admitted, gives results in opposition to Dr. Frankland's. Dr. Angus Smith who, as our readers know, has been for some time engaged in a very important investigation of the organic matter existing in the atmosphere, has also given in his adhesion to the other process, which he employs in his researches. The late Dr. W. A. Miller rejected Dr. Frankland's process and employed Mr. Wanklyn's in his later investigations undertaken for the medical department of the Privy Council. Dr. Voelcker, chemist to the Royal Agricultural Society, rejects Dr. Frankland's process and adopts the other. Dr. Letheby has often expressed a like opinion. Indeed, we scarcely know a single chemist of reputation who approves of Dr. Frankland's water analysis.

Our object in bringing these facts before chemists is that some step may be taken to remedy a state of affairs which certainly ought not to exist. We invite chemists to correspond with us on this subject; and should there be such an agreement among them as to render united action possible, we should advise a resort to the eminently constitutional practice of petitioning Parliament, so as to obtain a uniform statement of results in all the Government water analyses.

ON THE RELATIVE POWER OF VARIOUS SUBSTANCES IN ARRESTING PUTREFACTION AND THE DEVELOPMENT OF PROTOPLASMIC AND FUNGUS LIFE.*

By Dr. F. CRACE CALVERT, F.R.S.

This series of experiments was undertaken as being complementary to those described in my last paper, and consisted in adding to a solution of albumen, swarming with microscopic life, one-thousandth part of the substances already enumerated in that paper, and examining the results produced immediately after the addition of the substances, and after one, six, and sixteen days; but in this abstract, only the results obtained in the first and last cases will be noticed.

The solutions were placed in test-tubes similar to those described in my last paper.

The experiments were begun on September 20th, 1871, the solutions being kept at a temperature of 15° to 18° C.

In the standard solution, the amount of life and putrescence increased during the whole of the time.

The first class includes those substances which completely destroyed the locomotive power of the vibrios immediately, and completely prevented their regaining it during the time the experiments were conducted:—

Cresylic acid.

The second class contains those compounds which nearly destroyed the locomotive power of all the vibrios present when added, and afterwards only one or two could be seen swimming about in each field:—

Carbolic acid, sulphate of quinine, chloride of zinc, and sulphuric acid.

The third class are those which acted injuriously on the vibrios on their addition, leaving only a small number retaining the power of swimming, but which allowed the vibrios gradually to increase in number, the fluid, nevertheless, containing less life after sixteen days than the standard putrid albumen solution:—

Picric acid and sulpho-carbolate of zinc.

The fourth class includes those substances which acted injuriously at first, but permitted the vibrios to regain their former locomotive power, and which, after sixteen days, contained as much vibrio-life as the standard putrid albumen:—

Chloride of aluminium, sulphurous acid, and prussic acid.

The fifth class contains those compounds which acted injuriously at first, destroying the locomotive power of most of the vibrios, but which afterwards permitted the vibrios to increase more rapidly than in the standard albumen solution.

Bleaching-powder, bichloride of mercury, chlorine solution, caustic soda, acetic and nitric acids, sulphate of iron, and the sulpho-carbolates of potash and soda.

The sixth class contains those compounds which exercised no action on the animalcules, either at first or after sixteen days:—

Arsenious acid, common salt, chloride of calcium, chlorate of potash, sulphate of lime, bisulphite of lime, hyposulphite of soda, phosphate of lime, turpentine, and pepper.

The seventh class includes those substances which favour the production of animalcules, and promote putrefaction:—

Lime, charcoal, permanganate of potash, phosphate of soda, and ammonia.

* Abstract of a Paper read before the Royal Society.

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ON THE SEPARATION OF POTASH AND SODA.

By TH. SCHLŒSING.

AT a recent meeting of the Academy, M. Chevreul dwelt on the difficulties which are met with in the separation of potash and soda; the observations then made by the illustrious chemist will give interest to some researches which I have just made on this subject.

We know that the study of perchlorates led Serullas to adopt a very simple method of estimating potash. Having found that this base is the only one among those most frequently met with in the course of chemical analysis, which forms with perchloric acid a salt insoluble in alcohol, he advises that the bases should be converted into perchlorates, by employing, if necessary, the perchlorates of silver and baryta to eliminate and estimate the chlorine and the sulphuric acid, and to complete the precipitation of the perchlorate of potash by the aid of alcohol of 40° = sp. gr. 0·830. Although adopted at the time of its publication, this method of estimation now seems to have fallen into disuse. Perhaps Serullas was wrong not to quote the results of analysis in figures, this being the most efficient means of establishing the merit of a method; but what has been most wanting in his process is, I think, the reagent on the use of which it is based. Perchloric acid, indeed, has for a long time been only a substance kept for show in our collection of chemicals, and has always hitherto been, moreover, a product of very doubtful purity; and notwithstanding Dr. Roscoe's excellent researches, wherein a method of extracting perchloric acid in pure state from chlorate of potash is described, it has not taken its place among the ordinary chemical products of our laboratories.

I shall now proceed to demonstrate that Serullas's experiment becomes one of the most exact methods of analysis when pure perchloric acid obtained from perchlorate of ammonia is employed. Presently I shall describe a preparation of this salt which will admit of its being readily prepared, so that it may become a mercantile product. Supposing now that I have already obtained it in a pure state, I will first describe its use.

Dr. H. Sainte-Claire Deville has long since taught how to destroy ammonia in analysis by the application of dilute nitro-hydrochloric acid (aqua regia); by this means I convert the perchlorate of ammonia in a few minutes into a mixture of perchloric, nitric, and chlorhydric acids. But by reason of its less degree of volatility and greater chemical energy, perchloric acid completely expels the nitric and chlorhydric acids from their saline combinations; the mixture of the three acids behaves in this respect, and with chlorides and nitrates, like perchloric acid alone, and the bases are therefore converted into perchlorates; provided, however, that the amount present of the acid (perchloric of course) exceeds that of the bases, and provided also that the heat applied be sufficiently strong. It is thus seen that it is useless to use the perchlorates of silver and baryta, as advised by Serullas for the estimation of the chlorine and sulphuric acid. The chloride of barium and the nitrate of silver can here be applied as is usual, since the chlorhydric and nitric acids which they introduce will be afterwards expelled by the perchloric acid.

I now consider a mixture of chlorides or nitrates of potassa or soda. I suppose that the solution has been concentrated on the sand-bath in a small and previously weighed porcelain capsule. Into this the mixture of the three acids is poured, and is then evaporated. When the substance is nearly dry, it gives off a heavy white-coloured mass of vapours; this shows that the perchloric acid is in excess, and that the conversion of the salts is complete. When this evolution ceases, the capsule and contents are left to cool, and the perchlorate of potash is washed several times with small quantities of alcohol at 36° sp. gr. = 0·849, which should be decanted on a little filter for the purpose of retaining thereon the particles of the potassic salt (perchlorate) which are drawn off. The larger the quantity of the soda, the more of it is retained between the crystals of the perchlorate of potash. It is therefore advisable to dissolve the nearly completely washed perchlorate by the aid of heat in the smallest possible quantity of water, and next to evaporate it again to dryness. Two more washings with alcohol then complete the purification of the salt. The perchlorate collected on the small filter is dissolved in a few drops of boiling water, and this solution added to that contained in the capsule again evaporated to dryness and next heated to about 250°. The salt is then entirely desiccated and ready for being weighed. The alcoholic solution of perchlorate of soda is first evaporated in a little flask provided with a long neck, and the salt is next decomposed by heat; then re-dissolved in water and evaporated in a platinum crucible. But the chloride of sodium thus obtained often contains traces of perchlorate; it is better, therefore, to ensure an exact estimation, to convert it into sulphate. Instead of decomposing the perchlorate of soda by heat, it can be treated directly with sulphuric acid by operating in a porcelain vessel.

The following are the results of analysis :—

Operated upon.	Found.
643·2 m.gs. chloride of potassium. 385·5 m.gs. chloride of sodium. Used 2·2 grms. perchlorate of ammonia. „ 30 c.c. alcohol at 36°.	1193·9 m.gs. perchlorate of potassium = 643·2 m.gs. chloride of potassium. 467·8 m.gs. sulphate of sodium = 385·4 m.gs. of chloride of sodium.
Operated upon.	**Found.**
35·8 m.gs. chloride of potassium. 1296·7 m.gs. chloride of sodium. Used 3 grms. perchlorate of ammonia. „ 40 c.c. alcohol at 36°.	64·0 m.gs. perchlorate of potassium = 34·5 m.gs. chloride of potassium. 1294 m.gs. sulphate of sodium = 1570·5 m.gs. of chloride of sodium.
Operated upon.	**Found.**
777·2 m.gs. chloride of potassium. 2·3 m.gs. chloride of sodium. Used 2 grms. perchlorate of ammonia. „ 20 c.c. alcohol at 36°.	1143·0 m.gs. perchlorate of potassium = 777·0 m.gs. chloride of potassium. 2·9 m.gs. sulphate of sodium = 2·4 m.gs. chloride of sodium.

It will be seen that the method by perchloric acid permits of the separation of the potash and soda, even when one of the bases is present in a very small quantity as compared with the other. I have even been able to prove, viz., by this process, that my chloride of potassium, although purified by three crystallisations, still contains traces of soda. Indeed, 3·5 grms. of this salt converted into perchlorate left 5 m.gs. of perchlorate of sodium, equivalent to 2·5 m.gs. of chloride of sodium. This soda is not due to, nor derived from, the *vessels*, in which the operations were performed, for an experiment made simply with the reagents did not give any at all.

When the potash and soda are accompanied by sulphuric or any other *fixed* acids, these ought first to be eliminated by the ordinary methods. I have proved that the presence of lime, barytes, and magnesia, does not at

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all interfere with the correctness of the proper separation of the perchlorate of potash. The following is an example:—

Operated upon.	Milligrammes.
Chloride of potassium	83·5
Sulphate of magnesia	574·0
Chloride of sodium	1298·0
Chloride of calcium	233·0

After the elimination of the sulphuric acid by chloride of barium and conversion of the bases into perchlorates, I find:—

Perchlorate of potassa, 153·1 m.gs. = 82·4 m.gs. of chloride of potassium.

I ought to mention that by this process the separation of the potash may take place nearly at the beginning of an analysis, and thus the method becomes very expeditious when it is only a question of determining this base.

Preparation of the Perchlorate of Ammonia.

It includes three operations:—Preparation of the chlorate of soda; conversion by the aid of heat of the chlorate into perchlorate; next, the conversion of the perchlorate of soda into perchlorate of ammonia by chlorhydrate of ammonia.

The chlorate of soda can be obtained in large quantities either by treating with soda salt (carbonate of soda) the mixture of calcic chloride and chlorate which the solution of hypochlorite of lime yields when it is saturated with chlorine and heated to ebullition, or also by directly saturating the soda salt with chlorine. In several chemical treatises one reads that it is difficult to separate the sodic chloride and chlorate produced at the same time; but this is an error refuted by the following tabulated form:—

	Chlorate of soda.	Chloride of sodium.
100 parts of water dissolve at 12°	89·30	—
100 parts of water at 12°, shaken up with an excess of chlorate and chloride dissolve	50·75	24·4
100 parts of boiling water upon an excess of the two salts at 122°..	249·60	11·5
100 parts of this boiling hot solution, cooled down to 12°	68·60	11·5

Whence it is seen that 100 of water saturated at 122° with chlorate in the presence of chloride deposit by cooling 181 of chlorate, and that the common salt remains entirely in solution. Is it not evident from these results that the separation of the two salts presents no difficulty, and enters into the class of operations most familiar to manufacturers of chemical products?

The transformation of the chlorate of soda into perchlorate by heat is similar to that which chlorate of potash undergoes under the same conditions; it even appeared to me to proceed more completely, inasmuch as the evolution of oxygen becomes almost reduced to nought when the saline matter has become of a pasty consistency.

The result of the operation is a mixture of chloride of sodium, with a residue of chlorate, and, further, chiefly perchlorate. It is re-dissolved in the smallest quantity of water; after digestion a syrupy solution of perchlorate is obtained; the greater part of the chloride and chlorate being excluded from it, and remaining in the state of a crystalline precipitate, which is separated by filtration. The solution of the perchlorate mixed with some boiling water, and next saturated with hydrochlorate of ammonia, deposits, on cooling, large crystals of perchlorate of ammonia.

A chemist practising this method on a small scale will lose half of the materials; he will obtain from 250 to 300 grms. of perchlorate of ammonia from 1 kilo. of soda; but in a chemical manufacture, even for very secondary products, the materials are worked up in the proportions best suited to a certain course of operations; the successive saline deposits can be washed methodically and the mother-liquor utilised. When I advocate the use of chlorhydrate of ammonia for the conversion of the perchlorate of soda, it is because the mother-liquor boiled with some carbonate of soda to eliminate the ammonia will contain no other salt but the sodic chloride, chlorate, and perchlorate, and can, therefore, continually be used for dissolving perchlorate of soda afresh.

When the perchlorate of ammonia crystallises in the presence of potassic salts, it carries away some potash, from which it cannot be freed by repeated crystallisations; it is, therefore, absolutely required that the chlorate of soda used in the beginning of the operation be perfectly free from any potash. Its purity should be first tested by the very method of Serullas which I now endeavour to hand over to analysts. A second crystallisation suffices for its purification. In order to test the purity of the perchlorate of ammonia, it should be decomposed by dilute aqua regia, and next evaporated to dryness. No residue whatever ought to be left; the saline mass should completely be volatilised by the heat.—*Comptes Rendus.*

THE REGISTRAR-GENERAL'S REPORTS ON THE LONDON WATERS.

By J. ALFRED WANKLYN.

For the last five years the monthly reports of the quality of the London water supply have included some very extraordinary returns, viz., the proportions of "Previous Sewage Contamination (Estimated)" and of "Organic Carbon" and "Organic Nitrogen" in 100,000 parts of the different London waters.

Although to those chemists who have devoted special attention to the examination of drinking-water the nature of these returns may be pretty well known; yet, for the sake of others who have not so specially occupied themselves with this subject, and for the sake of engineers who refer to these returns hoping for valuable information from them, it may possibly not be useless to discuss them at the present time. "Previous Sewage Contamination (Estimated)" is a term employed by Dr. Frankland, who explained its meaning in a lecture delivered at the Royal Institution in the year 1867. The following are Dr. Frankland's own words:—"With certain corrections presently to be mentioned, the analytical determination of the nitrogen in these salts" (*i.e.* in the solid residue left on evaporating the water) "and in the form of ammonia, unites, as it were, the history of the water as regards its contact with decomposing animal matter. Such *previous organic contamination* may be conveniently expressed in parts of average filtered London sewage, which, if thus completely oxidised in a river, would yield a like amount of nitrogen in the form of nitrites, nitrates, and ammonia. For this purpose average filtered London sewage may be taken as containing 10 parts of combined nitrogen in 100,000 parts, as deduced from the numerous analyses of Way, Hofmann, and Witt. The number so obtained as the *previous sewage contamination* of a water requires, however, a correction, since rain water itself contains combined nitrogen as ammonia, nitrite of ammonia, and nitrate of ammonia." The correction which Dr. Frankland made for rain water was 0·0985 parts of nitrogen in 100,000 parts of water, and if my memory serves me rightly, some slight alteration of the correction has since been proposed. The amount of Previous Sewage Contamination in 100,000 parts of a sample of water is, therefore, found by determining the total nitrogen in 100,000 parts of the water, deducting 0·0985 parts from the total nitrogen, and finally multiplying the result by ten thousand. In this way we were said by Dr. Frankland to attain to an approximate idea of the proportion of sewage originally present in a given specimen of drinking-water.

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The annexed is a tabulated statement compiled from the Registrar-General's return for the past year (1871).

PREVIOUS SEWAGE CONTAMINATION (ESTIMATED). 1871.

Date.	Chelsea.	West Middlesex.	Southwark and Vauxhall.	Grand Junction.	Lambeth.	New River.	East London.	Kent.
Jan. 4, 16, and 17..	2990	2790	3540	2940	3100	2770	4020	3380
Feb. 8, 14, and 15 ..	3240	3590	3600	3620	3220	3450	4280	4360
March 9, 10	2320	2410	2150	2540	2280	2410	3000	3630
April 12, 13 and 15 ..	1470	1510	1460	1510	1440	1670	1470	4780
May 8, 9 ..	1750	1660	1810	1680	1990	1760	1470	3300
June 8, 9 ..	1090	970	1080	890	1200	1050	610	3260
July 3, 4 ..	1190	430	720	630	1140	1220	500	4100
September 4	420	420	410	460	610	1120	0	3460
Oct. 10, 11..	2490	1400	1420	1370	1390	2380	2290	3060
Nov. 13, 14, and 17 ..	1600	1860	1790	1980	2040	1890	1460	3470
Dec. 7, 8 ..	2270	2250	2270	2270	2460	2320	1480	4470

These figures profess to express the number of lbs. of average London sewage (or of the equivalent) which 100,000 lbs. of each of the above-named waters had received respectively.

Here, perhaps, we ought to say that from inspection of the Registrar-General's tables it appears that the nitrogen present as nitrates and nitrites is selected instead of the total nitrogen, and the correction 0·032 instead of 0·0985 for rain water is employed. Be this, however, as it may, we have copied the official returns exactly.

On turning to the table it will be observed that in September East London water showed zero as its Previous Sewage Contamination, and in October 2290, that is to say that 100,000 lbs. of this water had in September received no sewage at all, and in October 2290 lbs. of sewage. Obviously this cannot be true. Returning to Dr. Frankland's lecture in the year 1867, we find that occurrences of this kind were contemplated (*vide* the following):—"As summer advances and aquatic vegetation becomes vigorous in the bed of the Thames and its tributaries this coincidence of calculated and analytical results will doubtless be disturbed, as the water plants can scarcely fail to withdraw an appreciable amount of nitrates and nitrites from the water, thus diminishing the amount of combined nitrogen, and consequently of previous sewage contamination as determined by analysis."

It is a most extraordinary psychological fact that the author of that passage should have failed to see that if the influence of aquatic vegetation is so overwhelming that the same water-supply contains one month 0·017 of nitrogen (from nitrates) and the following month only 0·260 of nitrogen, the fluctuations in the nitrogen are measures of the activity of vegetation rather than of previous sewage contamination. In reference to this subject the *British Medical Journal* has very aptly observed that if Dr. Frankland were to endeavour to ascertain the relative wages of several workmen by counting their money at the expiration of the week he would exemplify his method of determining Previous Sewage Contamination.

In truth, if we determine the amount of nitrates in 100,000 parts of water and deduct from that the amount of nitrates present in average rain water, we get a number which means nothing in particular, and which certainly is no index to the goodness or badness of the water. It is high time that the Registrar-General of Great Britain should cease stultifying the national statistics by so ridiculous a return.

ASSAY OF IRON ORES.

By T. M. BLOSSOM, E.M.,
Assistant in Charge of the Assay Laboratory of the School of Mines, Columbia College.

THE oxides and carbonates are the only minerals of iron which can be used as ores in the blast-furnace. These are associated with different impurities or foreign materials in greater or less proportion. The following is a list of the principal ores of iron, with the maximum percentage of metallic iron that could occur in each, if it were absolutely pure, as in its formula:—

Magnetic iron ore	Fe_3O_4	72·4
Red hæmatite and specular ore	Fe_2O_3	70·0
Brown hæmatite, limonite	$2Fe_2O_3,3HO$	59·9
Spathic iron ore	FeO,CO_2	48·2
Ilmenite, titaniferous ore	$FeO,TiO_2+nFe_2O_3$	36·82
Franklinite	$3(FeO,ZnO,MnO)+(Fe_2O_3,Mn_2O_3)$	45·16

It is required, in the assay of an iron ore, to reduce the oxide of iron to the metallic state, or rather that of cast-iron, to collect it in a button, and to form with the foreign materials of the ore—by means of fluxes—a fusible slag that will not retain any of the iron, in combination, or in the form of pellets. The oxide is reduced by charcoal, and we employ for this purpose crucibles lined with charcoal brasque. The brasque has a composition of four parts of finely pulverised charcoal to one part of molasses. This must be thoroughly kneaded until a ball of it made in the hands resists, to a sensible degree, an attempt to pull it apart. The crucibles are packed full by driving the brasque in with a mallet; a conical cavity, of sufficient size for the charge, is then cut out, and the brasque dried in an oven. Care must be taken not to burn the molasses, for the brasque would in that case crumble, and be useless.

These are the best crucibles for iron assays, because they combine the following advantages:—

Being lined with charcoal, none need be mixed with the charge to reduce the oxide, whereas in naked crucibles charcoal must be added, and is liable to prevent the complete collection of the iron in a button by holding little pellets in suspension.

The slag neither adheres to a charcoal lining nor takes up any material from it, while it does adhere to ordinary naked crucibles, and dissolves argillaceous matter from black-lead crucibles. In the former case, then, the slag may be weighed as a verification of the assay, while in the latter this is, of course, impossible.

The lining serves as a support for the crucible, which, under the high heat employed, is very apt to be softened and crushed beneath the weight of the fuel.

The furnace has a cross section of 18 in. × 18 in., and depth to grate-bars 21 inches. Flue 7 in. × 7 in. The fuel used is anthracite.

The Charge.

In making up the charge it is only necessary to consider the materials required as fluxes for the foreign matters of the ores. It may be well to sprinkle a little charcoal into the charge, as a precaution, but *none is absolutely required*. Two cases may arise, in which we have (1) ores of unknown composition, and (2) ores previously analysed. The assay in both cases gives us a clue to the nature of the iron that may be obtained from the ore, and to the character and proportion of the fluxes to be added in the blast-furnace, in order that we may produce a fusible slag free from iron. In the former case we obtain the additional information of the approximate percentage of iron, though the iron assay is seldom, if ever, made for this purpose. Recourse is had to the more accurate chemical analysis,* which gives us the exact

* CHEMICAL NEWS, vol. xxiv., p. 292.

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proportions of the substances which affect the iron injuriously or otherwise. In all the assays a constant weight of ore, 10 grammes, is taken.

1. *Ores of Unknown Composition.*

In the assay of an ore the composition of which is unknown, we employ one or more preliminary assays, and, if satisfactory results be not obtained from either, we make another assay with a charge modified according to the indications of the preliminary assay. The following charge may be used to advantage in the preliminary assay:—

Preliminary Assay—Charges.

	I.	II.	III.	IV.	
Silica	2·5	1	4·0	2·5—0	grms.
Lime	2·5	4	1·5	2·5—3	,,
Ore	10·0	10	10·0	10·0	,,

1. The first charge is employed for the purer ores, those containing very little gangue, such as some varieties of magnetic ore, red and brown hæmatites, specular and micaceous ores.

2. Ores containing silica; some varieties of brown hæmatite, magnetic ore, &c.

3. Ores containing the carbonates of lime, of magnesia, of protoxide of manganese, &c.; calcareous hæmatites, spathic iron.

4. Ores containing silica and alumina; clay iron-stones, black-band, &c.

The principle involved in all the charges is that of furnishing a base, lime; for an acid, silica; and *vice versa*.

The choice of a charge, therefore, depends on the acid or basic nature of the gangue of the ore. The materials of the gangue might possibly be associated in such proportions as to flux themselves, but this would happen rarely.

Ores containing titanium require the addition of fluor-spar to the charge, in quantity varying from 0·5 to 10 grms., according to the amount of titanium present.

2. *Ores Previously Analysed.*

When we know the percentage composition of an ore, it is a very simple matter to calculate a charge for the dry assay. Good results are obtained from a charge so proportionate as to yield a slag corresponding to the following formula of a blast-furnace cinder, as given by Percy:—

$$R_2O_3,SiO_3+2(3RO,SiO_3).$$

R_2O_3 represents alumina, and RO, lime, magnesia, and other bases. Its approximate percentage composition is as follows:—

Silica	38	2½ parts
R_2O_3 (alumina)	15	1 ,,
RO (lime, magnesia, &c.) ..	47	3 ,,

We have, then, only to establish the latter relation between the component materials of the gangue, to obtain, on fusion, the above slag.

Let us take the following example:—

The Ore contains	P. c.	10 grms. Ore contain.	Required.	Difference to be added.
Silica	1·65	0·165	2·50	2·335 grms.
Alumina ..	1·94	0·194	1·00	0·806 ,,
Lime, MgO, &c.	4·51	0·451	3·00	2·549 ,,

Silica is supplied by ground quartz. For the bases RO represented in the furnace slag and in the ore by lime, magnesia, &c., we add pure unslaked lime. The alumina is added in the form of kaolin, which may be assumed to contain equal parts of alumina and silica. Allowance must be made in adding silica for that introduced with the kaolin.

It happens sometimes that the ore contains more than is required of one of the ingredients of the slag, or the silica introduced with the kaolin may, when added to that already present, increase the quantity beyond the requirement. In either case make up a new slag with the excess. The following is an example of both cases:—

The Ore contains	P. c.	10 grms. Ore contain	Required.	Difference to be added.
Silica	25·96	2·596	2·50	−0·096
Alumina	6·92	0·692	1·00	0·308
Lime, MgO, &c.	7·59	0·759	3·00	2·241

Kaolin ($Al_2O_3.\frac{1}{2},SiO_2\frac{1}{2}$) required to furnish 0·308

Al_2O_3	0·616
Silica contained in 0·616 kaolin	0·308
Silica in excess in ore	6·096
Total excess of silica	0·404

Add fluxes to make up with this excess more slag of composition as above.

	Excess.	Required.	Difference to be added.
Silica	0·404	2·50	2·096
Alumina		1·00	1·000
Lime, mag., &c. ..		3·00	3·000

Kaolin required to furnish 1·00 Al_2O_3 2·000
Silica contained in 2·00 kaolin .. 1·000
Silica to be added, 2·096 − 1·000 .. 1·096

Total material to be added to the charge:—

Silica	1·096
Kaolin .. 0·616+2·00	2·616
Lime .. 2·241+3·00	5·241

The charge having been weighed out, it must be thoroughly mixed on glazed paper; after placing it in the crucible, the conical cavity is closed with a piece of charcoal, and the whole top of the crucible is covered with a luting of fire-clay. The latter is mixed with ¼—½ part fine sand, and is made plastic with borax water. Hair is sometimes employed to prevent the luting from cracking off when dry; but no trouble is experienced from this source if the luting be properly made and applied. It should not be put on too thick, should be lapped over the edges of the crucible, and thoroughly dried before placing the crucible in the furnace.

Four crucibles are introduced at one time, and rest upon two fire-bricks placed one upon the other, to keep the crucibles in the very midst of the glowing coals. If the crucibles do not rest steadily on the brick, it is well to support them with a little luting, to prevent their being toppled over in the fire. A low fire may be kindled before the introduction of the crucibles, or it may be kindled around them. The fuel is added gradually until it fills the furnace above the tops of the crucibles; the fire is then maintained at its maximum temperature for 2½—3½ hours, according to the refractory nature of the ore. Ores containing much titanium may even require 4 hours, while carbonates containing manganese may fuse well in 2½ hours, or less time. Three hours will generally be sufficient for ores that do not contain much titanium. When the fire has burned out, the bricks and crucibles are removed in one mass, cemented together by the slag of the fuel. The crucibles are detached, and the exteriors broken with a hammer; on inverting and tapping the brasque lining, the slag and the button of cast-iron will fall into the hand, when, if they adhere together, a slight tap will suffice to separate them. Before separation, however, they should be carefully cleansed and weighed; if necessary, the slag may then be broken, and any particles of iron it retains mechanically may be extracted with a magnet. The weight of the iron being deducted from the weight of the slag and button, we obtain the weight of the slag. This ought to approximate closely to the weight of the fluxes introduced and the corresponding material of the ore. If a large amount of iron has combined with the slag, it will be indicated by the excess in weight. Titanium and manganese enter the slag almost completely; hence, if they are present, allowance must be made for them. Duplicate assays are made, and the two results should not differ more than 0·3—0·4 of 1 per cent. The *slag ought to be* well fused, colourless, transparent, and vitreous or

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white, light-gray, bluish-gray, opaque, and semi-vitreous, resembling porcelain or enamel.

A *good button* will be well formed, and will separate completely from the slag.

If the *metal be of good quality*, the button, when wrapped in a piece of thin tin plate, and struck on the anvil, will flatten slightly before breaking. It ought to be grey or greyish-white, and the grain fine, or tolerably fine. A button of bad iron breaks readily without changing form, sometimes even pulverising: the metal is generally white and crystalline an the surface.

The following are some of the characters that may be observed in slags and their indications with reference to the charge. A perfectly transparent slag of *greenish tint* indicates an excess of silica. A stony rough slag, or one that is crystalline in fracture and dull in lustre, indicates an excess of bases.

If the product, instead of being melted, is only fritted, and contains the reduced iron interspersed as a fine grey powder, both silica and alumina are deficient in the flux, lime and magnesia being in excess. The latter is one of the most refractory substances found in iron ores, and, when present in quantity, requires an addition of both silica and lime. A vesicular slag, with the iron interspersed in malleable scales, indicates the presence in the ore of silicates of iron and manganese, or an excess of silica, which react on the carburetted iron as it forms, producing malleable iron and carbonic acid. This trouble is corrected by the addition of lime.

Manganese in small quantity gives an amethystine tint to the slag; in larger proportion it produces a yellow, green, or brown colour.

Titanium often produces a resinous, black, and scoriaceous slag, sometimes curiously wrinkled on the outside. It is covered on the outside with a metallic pellicle of the nitrocyanide of titanium with its characteristic copper colour; sometimes the slag is vitreous and of a bluish tint. *Chromium* gives a dark resinous slag, sometimes surrounded by a thin metallic coating.

The following are some characters of the button dependent on the substances named:—

Phosphorus.—A hard, brittle, white metal, what is known as cold-short.

Sulphur.—A strong, reticulated, mottled structure, and red-short iron.

Manganese.—A button smooth exteriorly, hard and non-graphitic: it breaks under the hammer and presents a white crystalline fracture.

Titanium.—The button is smooth on the outside, and breaks under the hammer with a deep grey fracture, dull or crystalline. It adheres strongly to the slag. The button is covered, sometimes with the nitrocyanide of titanium with its characteristic copper colour. Titanium is said to increase the strength of the metal. It may be present to the extent of 1 per cent.

Chromium.—Sometimes the button is smooth, well fused, with a brilliant crystalline fracture and tin-white colour; at other times it is white, only half fused, or it may even form a spongy mass of a clear grey colour, according to the quantity of chromium contained in the iron. Many alloys of iron and chromium will scratch glass.—*American Chemist.*

CONTRIBUTIONS TO THE HISTORY OF THE OPIUM ALKALOIDS.*

By C. R. A. WRIGHT, D.Sc.,
Lecturer on Chemistry in St. Mary's Hospital Medical School.

Part IV.

I. *On the Action of Hydriodic Acid on Morphia in presence of Phosphorus.*

It has been shown in Part III. of these researches† that when hydriodic acid acts on codeia in presence of phosphorus, a series of products are ultimately obtained which may be considered as formed by the following train of reactions:—

$$\underset{\text{Codeia.}}{C_{18}H_{21}NO_3} + HI = CH_3I + \underset{\text{Morphia.}}{C_{17}H_{19}NO_3},$$

$$\underset{\text{Morphia.}}{C_{17}H_{19}NO_3} + 2HI = I_2 + \underset{\text{Hypothetical new base X.}}{C_{17}H_{21}NO_3},$$

$$\underset{\text{Hypothetical new base X.}}{C_{17}H_{21}NO_3} + 2HI = I_2 + H_2O + \underset{\text{Hypothetical new base X'}}{C_{17}H_{21}NO_2}.$$

These two hypothetical bases, X and Y, then serve as the foundations of two series of new products expressible by the general formulæ:—

$$4X + nHI \pm pH_2O,$$
$$4Y + nHI \pm pH_2O.$$

In accordance with these views, it might be anticipated that, on treating morphia with hydriodic acid and phosphorus, either the same products, or at least products belonging to these same series, would ultimately result, which is in fact the case.

The morphia used in these experiments was presented for the purpose by Messrs. Macfarlane of Edinburgh, to whom the writer has already been so much indebted for similar acts of liberality; the hydriodic acid was prepared as described in Part III., and contained 50 to 55 per cent of HI.

On dissolving morphia by the aid of heat in about four times its weight of this acid, a marked brown colouration is visible, indicating the separation of iodine; on adding phosphorus and continuing to heat, this colour ultimately disappears, a colourless syrupy liquid being obtained, which is freed from amorphous phosphorus and the phosphorous acids produced during the reaction by filtration through asbestos while hot, precipitation by water, &c., precisely as in the case of the similar codeia products. On then treating codeia, one or other of three products appear to be formed, according to the temperature employed, viz.:—

At 100°..	$4X + 6HI$.
At 110°–115° ..	$4X + 6HI - 2H_2O$.
Boiled up to 130°	$4Y + 6HI - 2H_2O$.

In the case of morphia, however, the resulting product is the same at whatever of these temperatures the reaction ensues, and has the composition $4X + 6HI - 2H_2O$. Thus the following numbers were obtained after complete drying at 100°:—

(A). Digested four hours at 100°.
0·3695 grm. gave 0·5920 CO_2 and 0·1710 H_2O.
0·3325 ,, 0·2410 AgI.

(B). Gently boiled ten minutes.
0·3955 grm. gave 0·6240 CO_2 and 0·1770 H_2O.
0·3465 ,, 0·2530 AgI.
0·4420 ,, 0·3260 AgI.

(C). Boiled till the thermometer stood at 132°.
0·3150 grm. gave 0·4990 CO_2 and 0·1400 H_2O.
0·4405 ,, 0·3280 AgI.

	Calculated.		Found.			Mean.
			A.	B.	C.	
C_{68}	816	43·40	43·69	43·03	43·20	43·31
H_{86}	86	4·58	5·14	4·97	4·94	5·02
I_6	762	40·53	39·17	39·46	39·86	40·24	39·68
N_4	56	2·98				
O_{10}	160	8·51				
	1880	100·00				

$C_{68}H_{82}I_2N_4O_{10},4HI$

Hence this product is found from morphia in accordance with the equation

$$4C_{17}H_{19}NO_3 + 14HI = 2H_2O + 4I_2 + C_{68}H_{82}I_2N_4O_{10},4HI.$$

In physical properties and qualitative reactions the substance thus got is indistinguishable from the product of the same composition obtained from codeia; like the

* Read before the Royal Society.
† *Proc. Roy. Soc.*, vol. xx., p. 8.

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codeia product, too, it loses the elements of HI on long-continued boiling with water.

II. *Action of Water on the foregoing Compounds.*

When the original substance $C_{68}H_{82}I_2N_4O_{10},4HI$ is boiled for five hours with about three hundred times its weight of water, a liquid is obtained from which white flakes separate on cooling; these have the same curious microscopical structure as the body similarly obtained from codeia, and gave the following numbers after drying at 100°:—

0·3680 grm. gave 0·6220 CO_2 and 0·1770 H_2O.
0·4240 „ 0·7165 CO_2 and 0·2050 H_2O.
0·3780 „ 0·2520 AgI.

	Calculated.		Found.	
C_{68}	816	46·58	46·10	46·09
H_{85}	85	4·85	5·34	5·37
I_5	635	36·24	36·02	
N_4	56	3·20		
O_{10}	160	9·19		
$C_{68}H_{81}IN_4O_{10},4HI$	1760	100·00		

Hence this substance is formed by the reaction

$$C_{68}H_{82}I_2N_4O_{10},4HI = HI + C_{68}H_{81}IN_4O_{10},4HI,$$

identical with that which takes place with the corresponding compound in the codeia series.

When the compound $C_{68}H_{81}IN_4O_{10},4HI$ from codeia is further treated with excess of water and boiled for several hours, a further elimination of the elements of HI has been shown to take place, the end product having the composition $C_{68}H_{80}N_4O_{10},4HI$; as stated in Part III., however, it is very difficult to push this reaction to its extreme. Precisely the same facts are observable with the above morphia product; by boiling this with three hundred times its weight of water for three hours, half the basic iodine it contains is eliminated as HI, forming a product which may be either a mixture of equivalent quantities of $C_{68}H_{81}IN_4O_{10},4HI$ and $C_{68}H_{80}N_4O_{10},4HI$, or a single substance of the formula $C_{136}H_{161}IN_4O_{10},8HI$. If this latter be the case, the formulæ hitherto attributed to the derivatives from codeia and morphia obtained by the action of HI are only half the true ones; and the formation of this substance may be expressed by the equations

$$C_{136}H_{164}I_4N_8O_{20},8HI = 2HI + C_{136}H_{162}I_2N_8O_{20},8HI,$$
$$C_{136}H_{162}I_2N_8O_{20},8HI = HI + C_{136}H_{161}IN_8O_{20},8HI.$$

The following considerations tend to show that this body is a single substance and not a mixture:—

1st. By treating the compound hitherto described as $C_{68}H_{81}IN_4O_{10},4HI$ from codeia with water, a body which has the composition of $C_{136}H_{161}IN_8O_{20},8HI$ is produced previously to the production of the substance hitherto described as $C_{68}H_{80}N_4O_{10},4HI$. Now it is not probable that in two separate instances *one* compound should split up into mixtures of *two* bodies of analogous though slightly different constitutions, these two being formed in each case in *equivalent quantities*.

2nd. A body which is without doubt a single compound and which has the formula $C_{136}H_{153}IN_8O_{20},8HI$, has been produced (as will be described in a subsequent communication) by the simultaneous action of HI and P on a polyamide of codeia obtained from that base by the action of phosphoric acid; in physical and chemical properties this product much resembles the two bodies thus obtained from morphia and codeia products by the action of water; and hence these two bodies probably contain, like it, C_{136} associated with I in the base.

In order to show the resemblance between, or rather the identity of, the codeia and morphia products, the formulæ given in Part III. have been adopted in this paper (viz., those containing C_{68}); but the author has no doubt that each of the substances has really double the [illegible] ascribed to it (*i.e.* that each contains C_{136}).

[illegible] substances of compositions $C_{136}H_{161}IN_8O_{20},8HI$ above-mentioned from codeia and morphia products by the continued action of water gave the following numbers on analysis after drying at 100°:—

A. Codeia product—
0·3985 grm. gave 0·7050 CO_2 and 0·200 H_2O.
0·3670 „ 0·2280 AgI.

B. Morphia product—
0·3120 grm. gave 0·5635 CO_2 and 0·1610 H_2O.
0·3140 „ 0·5560 CO_2 and 0·1570 H_2O.
0·2840 „ 0·1775 AgI.

	Calculated.		Found.		
			A.	B.	
C_{136}	1632	48·34	48·25	48·17	48·29
H_{161}	169	5·01	5·55	5·61	5·55
I_9	1143	33·86	33·57	33·77	
N_8	112	3·31			
O_{20}	320	9·48			
$C_{136}H_{161}IN_8O_{20},8HI$	3376	100·00			

In physical character and chemical deportment the derivatives from morphia obtained as above described are indistinguishable from those of the same composition obtained from codeia. The physiological experiments of Mr. Stocker given in the next section show that no particular difference is discernible in this respect also; hence it is concluded that the codeia products are not merely isomeric, but are identical with the corresponding morphia derivatives.

From the fact that hydriodic acid alone does not eliminate methyl from codeia in the form of methyl iodide, but causes the separation of free iodine, it appears more probable that the formation of the compound $C_{68}H_{82}I_2N_4O_{10},4HI$ obtained by the action of hydriodic acid in presence of the phosphorus on codeia is brought about in accordance with the equations:—

$$(1).\ 4C_{18}H_{21}NO_3 + 14HI = 4I_2 + 2H_2O + C_{72}H_{90}I_2N_4O_{10},4HI,$$
$$(2).\ C_{72}H_{90}I_2N_4O_{10},4HI + 4HI = 4CH_3I + C_{68}H_{82}I_2N_4O_{10},4HI,$$

rather than the equations—

$$(3).\ C_{18}H_{21}NO_3 + HI = CH_3I + C_{17}H_{19}NO_3,$$
$$(4).\ C_{17}H_{19}NO_3 + 2HI = I_2 + C_{17}H_{21}NO_3,$$
$$(5).\ 4C_{17}H_{21}NO_3 + 6HI = 2H_2O + C_{68}H_{82}I_2N_4O_{10},4HI;$$

i.e., that the action does *not* consist in the production o morphia from codeia and its subsequent alteration by addition of H_2, polymerisation, addition of 2HI, and subtraction of $2H_2O$; but that these alterations take place in the codeia molecule before the elimination of methyl as CH_3I, this elimination forming the last stage instead of the first; this circumstance may account for the non-production from morphia of compounds belonging to the series $4Y + nHI \pm pH_2O$, which are formed from codeia when the temperature of the reaction reaches 130°, and under other circumstances; for it might naturally be expected that the elimination of the methyl group would place a portion of the molecule in a quasi-nascent condition, thereby rendering further changes more easy.

The foregoing experiments, taken into consideration with the late Dr. Matthiessen,* lead to several noteworthy conclusions and speculations.

(1). The actions of hydrochloric, hydrobromic, and hydriodic acids on morphia and codeia are not precisely analogous; thus the action of HCl appears to give rise more especially to products derived from non-polymerised bases; *e.g.*, chlorocodide, which regenerates ordinary codeia by the action of water.† By the action of HBr,

* Matthiessen and Wright, *Proc. Roy. Soc.*, vol. xvii., pp. 455, 460; and vol. xviii., p. 83.

† Experiments are in progress which appear to show that the action of HCl on both codeia and morphia is capable of giving rise, when pushed to an extreme, of bases insoluble in ether, and of characters similar to chloro- and bromo-tetracodeia, with less ease, however, than HBr.

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codeia yields not only bases apparently formed from non-polymerised codeia (bromocodide, deoxycodeia, deoxymorphia), but also bases derived from polymerised codeia and accordingly containing at least C_{72}, and probably C_{144} (chloro- and bromo-tetracodeia). Hydriodic acid, on the other hand, yields no body whose formula can be written as containing less carbon than C_{34}, and from the physical characters of the first products of the action and the constitution of their derivatives (many of which contain at least C_{68} and some apparently C_{136}), this proportion of carbon must certainly be doubled and probably quadrupled.

Hence HCl yields single molecule derivatives chiefly; HBr yields single molecule derivatives, and also polymeride derivatives, the polymerides containing at least C_{68} or C_{72} (possibly the formulæ attributed to bromotetracodeia and analogous bases may require doubling, as the physical character of the bases and other salts indicate that they belong to the same rank as the iodine derivatives); HI yields polymeride derivatives only.

(2). It being assumed that the molecules of codeia and morphia contain respectively either C_{18} and C_{17} or C_{36} and C_{34} (which latter is probably the case, experiments now in progress indicating that the molecular formulæ of these bases are double those usually ascribed to them), the above experiments lead to the conclusion that there exist polymerides of these alkaloids containing C_{72} C_{144}, ..., or C_{68}, C_{136}, ..., these polymerides being formed by the action of strong acids, and serving as starting-points for new series of derivatives; experiments to obtain these polymerides in an unaltered condition are, as has been previously stated, in progress, and apparently with success.

This facile disposition to form polymerides is not an unknown feature in alkaloids, the experiments of Anderson having shown that the pyridine bases are characterised by this property; this fact would appear to warrant the speculation that morphia and codeia contain carbon groups analogous to, if not identical with, those contained in the pyridine bases; and, in fact, experiments now in progress, in conjunction with Herr L. Mayer, apparently lead to the conclusion that pyridine is obtainable from morphia derivatives by treatment which, though energetic, is nevertheless far short of destructive distillation: indeed it may be doubted whether the carbon groups contained in the pyridine series of bases do not pre-exist in the bodies from which these bases are obtained by destructive distillation.

(3). A comparison between the formulæ of the products obtained by the three hydracids HCl, HBr, and HI shows that while the action of HCl is simply to replace OH by Cl, or to remove the elements of H_2O (sometimes also replacing CH_3 by H), that of HBr is (in addition to the changes produced by HCl) to cause the addition of hydrogen to that one of the two resulting products that is derived from the non-polymerised molecule. Thus—

HCl and codeia give $C_{17}H_{17}NO_2$, apomorphia,
HBr ,, ,, $C_{17}H_{19}NO_2$, deoxymorphia,

which may be represented as $C_{17}H_{19}NO_3 - H_2O + H_2$.

This hydrogenising action is carried still further in the case of the derivatives obtained by HI; thus the expressions

$$4C_{17}H_{19}NO_3 - 2H_2O + 2HI + H_8,$$
$$4C_{17}H_{19}NO_3 - 6H_2O + 2HI + H_{16}$$

represent the composition of the bases obtained respectively from morphia and codeia at 130°.

(4). Codeia appears to be a species of methylic ether of morphia, their relative constitutions being probably

$$C_{17}H_{17}NO\begin{Bmatrix}OH\\OCH_3\end{Bmatrix} \text{ and } C_{17}H_{17}NO\begin{Bmatrix}OH\\OH\end{Bmatrix}$$

(doubling the formulæ will not alter their relations in this respect). Adhering to the formula hitherto employed, the production of the same apomorphia from both alkaloids is readily accounted for thus:—

Codeia. Chlorocodide.
$$C_{17}H_{17}NO\begin{Bmatrix}OH\\O.CH_3\end{Bmatrix} + HCl = C_{17}H_{17}NO\begin{Bmatrix}Cl\\O.CH_3\end{Bmatrix} + H_2O,$$

Chlorocodide. Apomorphia.
$$C_{17}H_{17}NO\begin{Bmatrix}Cl\\O.CH_3\end{Bmatrix} = \begin{Bmatrix}Cl\\CH_3\end{Bmatrix} + C_{17}H_{17}NO\begin{Bmatrix}O'',\end{Bmatrix}$$

Morphia. Apomorphia.
$$C_{17}H_{17}NO\begin{Bmatrix}OH\\OH\end{Bmatrix} = H_2O + C_{17}H_{17}NO\begin{Bmatrix}O''.\end{Bmatrix}$$

According to this view morphia should contain two hydroxyl groups for every C_{17}, and codeia only one. Experiments are contemplated, with reference to this point, on the action of aniline, acetyl chloride, and glacial acetic acid, and on these alkaloids, whereby it is hoped that definite information may be gained as to the presence, or otherwise, and the number of the groups CHO (aldehyde group), OH, &c.

(5). It appears not improbable that codeia and morphia may contain in their molecules benzine residues. Schiff has pointed out* that phenols give colourations with ferric chloride, whereas the corresponding ethers or anisols do not do so; the well-known distinction between morphia and codeia in this respect, therefore, gives some support to the idea that both may be benzine derivatives.

III. *On the Physiological Action of some of the foregoing Derivatives.* By REGINALD STOCKER, M.B., Pathologist in St. Mary's Hospital Medical School.

Doses of 1 decigramme of the compound
$C_{68}H_{81}IN_4O_{10},4HI$
from codeia, and of the similar compound from morphia, were given to an adult terrier by the mouth without producing any perceptible effect whatever; when the dose was increased to 3 decigrammes, in each case repeated defæcation in the course of a few hours was produced, the stools being more loose than ordinarily and frequently of a dark greenish colour; no other symptom was noticeable, and no appreciable difference in the action of the two compounds was perceptible.

Doses of 5 decigrammes of the compound
$C_{68}H_{82}I_2N_4O_{10},4HI$
from each of these sources were given to the same dog by the mouth with the result of producing similar repeated defæcation in the course of two or three hours; the sole difference discernible between these and the former experiments being that the effect was produced somewhat sooner and was of longer continuance in the latter cases, a result probably produced solely by the larger dose. No material differences were observed between the codeia and morphia derivative.

The same dog was employed throughout, two or three days being allowed to intervene between each experiment, so that the animal had recovered from the effects of a former dose before the administration of another.

It would hence appear that the derivatives of polymerised $C_{17}H_{21}NO_3$ are less active than those of polymerised $C_{17}H_{19}NO_3$; and also that there is no reason for considering the derivatives from codeia as different from those of morphia, the corresponding bodies having respectively the same quantitative composition and the same physical, chemical, and physiological properties.

ON SOME NEW DERIVATIVES OF ALBUMEN.

By O. LOEW.

Additional Note.

SINCE my last communication, I have made some further investigations in regard to the reduction of the hexanitro-albumen-sulphonic acid. I found my supposition confirmed, that all (NO_2) is replaced by (NH_2). After many attempts to isolate the product of reduction, I adopted the following as the best method:—Hexanitro-albumen-sulphonic acid is dissolved in not too great an excess of ammonia, and a current of sulphuretted hydrogen gas passed through it for some time. The solution, saturated

* *Ann. d. Chem. u. Pharm.*, vol. cix., p. 156.

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with sulphuretted hydrogen, is heated in a flask over a water-bath, till all sulphide of ammonia is volatilised (I cannot recommend evaporating in a porcelain dish, because the free access of air would effect an oxidation of the newly-formed product). The fluid is then filtered from the deposit of sulphur, and to the filtrate acetic acid is added till the formation of a precipitate ceases; this precipitate is then well washed with water and alcohol, and carefully dried.

Analysis of this precipitate resulted as follows:—

0·743 grm. gave 0·211 barium sulphate = 3·92 per cent sulphur.

0·248 grm. gave 44·13 c.c. nitrogen, at 14° C. and 7·42 m.m. barometer = 19·02 per cent nitrogen.

0·331 grm. gave 0·584 grm. carbonic acid and 0·203 grm. water = 48·12 per cent carbon, and 6·87 per cent hydrogen.

We have therefore all the (NO_2) here replaced by (NH_2), thus forming the corresponding hexamido-albumen-sulphonic acid:—

$$C_{72}\left\{\begin{matrix} H_{100} \\ (NH_2)6 \\ SO_2OH \end{matrix}\right\}N_{18}SO_{22}$$

	Theory.	Experiment.
C	48·593	48·12
H	6·412	6·87
N	18·897	19·02
S	3·599	3·92
O	22·497	—

This compound is a yellowish-brown powder, almost tasteless, insoluble in dilute acids, soluble in concentrated hydrochloric acid; alkalies dissolve it readily, but on the application of heat a decomposition takes place, with development of ammonia. Nitric acid attacks it with energy, and dissolves it with disengagement of nitrous fumes. I made many attempts to obtain crystalline combinations of this substance, but in vain.

The circumstance that albumen will yield a nitro-derivative, which, upon reduction, is converted into an amido derivative, makes it highly probable that it (albumen) contains radical complexes of the aromatic series. (The formation of tyrosin from albumen leaves this even beyond doubt.) Further investigation will demonstrate which special group in the complex of albumen replaces its hydrogen by (NO_2). Perhaps I shall be able to furnish some information at a future time.—*American Chemist.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Anniversary Meeting, March 30th, 1872.

At this, the thirty-first Anniversary Meeting of the Society, the President, Dr. Frankland, F.R.S., delivered the customary address to the Fellows. This will in due course be printed and circulated amongst the members, whose number at the present time is 656, including 32 foreign members. In the obituary of deceased members whom we have lost during the past year, we may note particularly the names of Fritzche, of St. Petersburgh, Strecker, of Tübingen, and our countryman Sir Roderick Murchison. At the conclusion of the address the President remarked that, however satisfactory the numerical increase of the Society might be, the comparatively small number of original communications sent in, not one-tenth of those of the Berlin Society, was a sign of the apathy and lethargy from which chemical science seemed to be suffering in this country; this he attributed, to a great extent, to the universities granting degrees to persons without requiring from them any proof that they are capable of conducting original research. After the Treasurer had read his financial statement, from which we were glad to see that, notwithstanding the very heavy expenses entailed by the new form given to the *Journal* the balance in hand was larger than usual, the balloting for the Officers and Council was proceeded with, Dr. Divers and Dr. Wright acting as scrutators.

The following is a list of the Officers:—

President—E. Frankland, D.C.L., F.R.S.

Vice-Presidents who have filled the office of President—Sir. B. C. Brodie, F.R.S.; Warren de la Rue, Ph.D., F.R.S.; A. W. Hofmann, D.C.L., F.R.S.; Lyon Playfair, Ph.D., C.B., F.R.S.; A. W. Williamson, Ph.D., F.R.S.; Col. P. Yorke, F.R.S.

Vice-Presidents—H. Debus, Ph.D., F.R.S.; H. M. Noad, Ph.D., F.R.S.; W. Odling, M.B., F.R.S.; J. Stenhouse, Ph.D., F.R.S.; and W. J. Russell, Ph.D., and Maxwell Simpson, Ph.D., F.R.S., in place of J. H. Gilbert, Ph.D., F.R.S., and T. Redwood, Ph.D., who retire.

Secretaries—A. Vernon Harcourt, M.A., F.R.S., and W. H. Perkin, F.R.S.

Foreign Secretary—H. Müller, Ph.D., F.R.S.

Treasurer—F. A. Abel, F.R.S.

Other Members of Council—H. Bassett; A. Dupré, Ph.D.; F. Field, F.R.S.; H. McLeod; H. E. Roscoe, Ph.D., F.R.S.; R. Angus Smith, Ph.D., F.R.S.; A Voelcker, Ph.D., F.R.S.; and A. Crum Brown, D.Sc., Dugald Campbell, G. C. Foster, F.R.S., Hermann Sprengel, Ph.D., Thomas Stevenson, M.D.; the five last being instead of E. Atkinson, Ph.D., C. L. Bloxam, M. Holzmann, Ph.D., E. J. Mills, D.Sc., and W. J. Russell, Ph.D., who retire.

After the names of the Officers and Council for the ensuing year had been announced from the chair, votes of thanks were proposed to the President, to the Officers and Council, to the Auditors, and to the Editor of the *Journal* and Abstractors.

GLASGOW PHILOSOPHICAL SOCIETY.

(Chemical Section).

Ordinary Meeting, March 25th, 1872.

Dr. Wallace, F.R.S.E., President, in the Chair.

"*The Metallurgy of Lead*," by Mr. John Jex Long.

The author read the first part of a paper on this subject, in the course of which he described the operations which he had personally witnessed at the works of the London Lead Mining Company, at Middleton-in-Teesdale, a few miles from Barnard Castle, where the mining operations were commenced about 170 years ago. He explained the geological position of the lead-bearing rocks in Teesdale, describing the direction, extent, and richness of the mines, and their mode of occurrence in flats, pockets, strings, &c. The annual product of the mines referred to is about 2000 tons of metallic lead, containing about 9 ozs. of silver per ton, which is separated in the metallic form by Pattinson's process. Before the company obtained any pecuniary return from the mines they had to expend about £30,000. Mr. Long described his exploration of the Coldberry Mine at Middleton, the mode of working it, and the various mechanical operations by which the mineral is prepared for smelting, and he promised, on a subsequent occasion, to devote the second part of his paper to the consideration of the smelting and refining processes and the extraction of the silver. The paper was profusely illustrated by specimens.

MISCELLANEOUS.

On the Preparation of Anthracen.—This hydrocarbon, which has attained a great importance as material for the artificial preparation of the madder colours, is found in the last products of the distillation of coal-tar, which, under the name of "green grease," are sometimes

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sold as axle grease. They consist of a heavy oil, some naphthalin, and about 20 per cent of anthracen. In the whole, the amount of anthracen in coal-tar is only from ½ to 1 per cent. In order to separate the oily products from the solid hydrocarbons, this soft mass is introduced into a centrifugal machine; the residue left is heated to about 110° F., and subjected to the action of a hydraulic press. If the crude material is thin, it is best to employ at once a filter press. The resulting mass, which contains about 60 per cent of anthracen, is exhausted with benzole or gasoline, again subjected to the centrifugal machine, in order to separate the last portions from the light oils. There remains a greenish-white, paraffin-like mass of a beautiful crystalline fracture, containing 95 per cent of anthracen, from which, by sublimation, a perfectly pure product having a melting-point of 420° F. can be obtained. Wartha, in the *Mittheilungen der Deutschen Chemischen Gesellschaft*, states that the anthracen may be very conveniently obtained pure, if by means of a blower a strong current of air is directed into the retort while the anthracen is at the boiling-point. The writer of this would remark that years ago, in conjunction with Orazio Lugo, of Baltimore, he purified naphthalin in exactly the same manner. The anthracen thus evaporates in a surprisingly short time, and may be collected in a large tubulated glass balloon, where it is deposited as a pale, yellowish, snow-like mass. It is important that the distillation of the tar be carried only to the point when products of pitch-like consistency begin to pass over. If the distillation be allowed to go further, hydrocarbons with a higher boiling-point will distil, and these can only with difficulty be separated from the anthracen, thus making it unfit for the preparation of colours. This is especially true of the chrysene, which differs from the anthracen by its lesser solubility in sulphide of carbon.—*Prof. Phin, in the Technologist.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Polytechnisches Journal von Dr. E. M. Dingler, second number for February, 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Coking.—C. Balling.—A practical treatise on the best means of preparing coke on the large scale in ovens, and on the most suitable construction of the latter.

Danks's Rotating Puddling-Furnaces.—The detailed description, illustrated by engravings, of a peculiarly constructed puddling-furnace for iron-works.

Talmi Gold.—Dr. C. Winkler.—This lengthy essay contains information on the alloys now frequently employed for making imitation jewellery, also known as Abyssinian gold, with other *aliases*. The author points out that the alloy is not galvanically gilt, but is plated, that is to say, a very thin sheet of gold is made to adhere to a yellow metal (in 100 parts—Copper, 90·74; zinc, 8·33) by rolling the metals together, and afterwards shaping, moulding, and chiselling it by means of steel tools, the amount of gold varying from 1·03 to 0·03 per cent. As regards wear and tear, the author admits that, by careful plating, these articles really answer well.

Report on Berthelot's Memoir on the Power of Gunpowder and other Explosive Substances.—Dr. R. Wagner.—An excellent review and copious well-digested abstract on the memoir edited by Dr. Berthelot at the end of last year under the title "Sur la Force de la Poudre et des Matières Explosives;" Paris, Gauthiers-Villars.

Means of Detecting and Estimating Paraffin Present in Stearine Candles.—M. Hock.—As regards the qualitative testing for stearine, the author recommends Drs. Wagner and Hofmann's method (see CHEMICAL NEWS, vol. xvi., p. 78), but states that it is preferable to saponify the stearic acid first, and then to extract the paraffin from the soap by a suitable solvent, or, better still (also applicable for quantitative purposes), to treat the potassa-soap with common salt, whereby a soda-soap is formed, which is next dissolved in water, leaving the granules and grains of paraffin free.

Nägeli's Wort-Cooling Apparatus.—A. Nägeli.—Illustrated with engravings. An apparatus constructed upon the plan of Liebig's condenser, very efficient in action, inexpensive, and readily kept sweet and clean.

American Journal of Pharmacy, March, 1872.

In addition to several valuable original papers more particularly relating to the practice of pharmacy, this number contains the following original papers relating to chemistry:—

Abietene, a New Hydrocarbon.—W. Wenzell.—This hydrocarbon is the product of distillation of the terebinthinate exudation of a coniferous tree indigenous to California, viz., the *Pinus sabiniana*, a tree met with in the dry sides of the foot hills of the Sierra Nevada mountains, and locally known as the nut-pine or digger-pine, owing to the edible quality of its fruit. A gum resin, or rather balsam, is obtained from this tree by incisions made in its wood, and the balsam submitted to distillation almost immediately after having been collected, owing to the great volatility of the hydrocarbon (or essential oil, because abietene really stands in the same relation to the balsam alluded to as oil of turpentine stands to the exudation derived from other *Pinus* species). The crude oil, as usually met with for sale at San Francisco, is a colourless limpid fluid, requiring only to be redistilled to obtain it quite pure. The commercial article is used under different names—abietine, erasine, theoline, &c.—for the removal of grease and paint from clothing and woven fabrics, and likewise as an efficient substitute for petroleum-benzine. Pure abietine (the commercial article having been ascertained by the author to be a homogeneous liquid) is a colourless fluid, exhibiting a strongly penetrating odour bearing some resemblance to oil of oranges; sp. gr. at 16·5° = 0·694: it is very volatile, highly combustible, burning with a brilliant white smokeless flame, almost insoluble in water, and soluble in 5 parts of alcohol at 95 per cent. Abietine is not acted upon by dry hydrochloric acid gas nor by nitric acid (sp. gr. = 1·43) in the cold, but heat being applied a slight reaction took place; neither concentrated sulphuric acid nor potassium act upon this hydrocarbon; when treated with chlorine, abietine is converted into fluid of the consistency of glycerine, insoluble in water, colourless, soluble in warm alcohol, and having a sp. gr. = 1·666. Abietine readily dissolves iodine and bromine, and is a powerful solvent for fixed and volatile oils, castor oil excepted, and also Peru balsam and Canada balsam; castor oil is absolutely insoluble in abietene, while, curiously enough, the last-named substance is dissolved by castor oil to some extent. When burned in an ordinary spirit-lamp (such as are used in chemical laboratories) with not too large a flame a brilliant white light is obtained without smoking; the vapour of abietine is a powerful anæsthetic when inhaled, and it has been used with success as an insecticide against moths, &c., when sprinkled in closed receptacles. The ultimate composition of abietene is not stated, but the author points out at some length the differences existing between abietene and terebene (oil of turpentine).

Bromide of Calcium.—J. R. Mercein.—It appears that bromide of calcium is now used in medicine, and it is of importance to prepare it free from uncombined lime; this is effected by the author in the following manner:—5 ozs. of bromine and 2½ pints of water are put into a sufficiently large-sized jar, and a stream of sulphuretted hydrogen slowly passed into this, care being taken to place the end of the delivery-tube so as to touch the surface of the bromine; this operation is continued until all the bromine is taken up, and the resulting liquid is next filtered, for the purpose of removing the sedimentary and suspended sulphur. The filtrate is next gently heated to drive off any trace of S_2O_3, and again filtered; the result is a strong solution of hydrobromic acid, which is next saturated with precipitated carbonate of lime in very slight excess. This solution is again filtered, evaporated upon a water-bath to syrupy consistence, and then stirred until it cools; the result is the obtaining of 6 ounces of bromide of calcium, freely soluble in twice its weight of water, and perfectly free from uncombined line.

Meat and the Methods of Preserving it.—Dr. H. Endemann.—Reserved for full reproduction.

Journal de Pharmacie et de Chimie, March, 1872.

This number contains the following original papers and memoirs:—

Preparation of Ozone in Concentrated State.—A. Houzeau.—After describing at some length an apparatus which the author calls an *ozoniseur*—a glass tube wherein, by means of platinum wires fixed therein, electric sparks can be made to pass in oxygen previously introduced into that tube, the effect being that that gas is converted into ozone—the author next describes a series of experiments made with ozone, to exhibit its action on metallic silver, iodide of potassium, chlorhydric acid, ammonia, sulphuretted hydrogen, phosphuretted hydrogen, and organic substances, including indigo solution.

Report on Digitaline.—Dr. Buignet.—This memoir contains the detailed account of a series of pharmaceutico-chemical experiments on the best method of preparing digitaline from the digitalis herb (*Digitalis purpurea*, foxglove). The main point of interest in this memoir is that the herb contains, in addition to digitaline (the active principle, insoluble in water), also digitaleine, an amorphous bitter-tasted substance, soluble in water, while the author also distinguishes digitine, an amorphous bitter-tasted matter, digitaline in pure state

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being crystalline; the best method of preparing the latter body for pharmaceutical purposes is described at great length.

Method of Detecting the Adulteration of Wax with Tallow by the Aid of Alcohol.—Dr. Hardy.—The author first prepared pure beef-suet, and carefully determined the specific gravity of this substance, which he found to be 0·8863; next he prepared an alcoholic fluid of such a degree of concentration that a piece of the suet alluded to remained suspended (that is to say, sunk therein to a certain depth, and then remained at rest) in it. This alcohol was found to have a specific gravity of from 0·8882 to 0·8857 (between 71° and 72°); the specific gravity of wax is between 0·962 and 0·963; hence it follows that alcohol at 29° will keep wax suspended. Starting from these data, the author has constructed a tabulated form, by the aid of which it becomes possible to detect adulterations of wax with suet (tallow).

Examination of a Small Sample of a Substance Designated as a Perfume from Ancient Egypt.—Dr. Personne.—The author accidentally obtained a small piece of a chocolate-brown substance, which originally was apparently a paste, but is now hard. On further examination it was found to consist of a lime-soap, mixed with myrrh, olibanum, benzoin, and probably some essential oil. The author states that at the present day there is sold in Egypt as a perfume a substance of similar composition, and locally known as *Bouh Kourre-bare*, which means perfume from the Arabian frontier.

Gazzetta Chimica Italiana, No. 1, 1872.

This number contains the following original papers:—

Researches on Benzilated Phenol.—Dr. E. Paterno.—After first referring to his preliminary researches on this subject (see CHEMICAL NEWS, vol. xxv., p. 22), the author treats in this essay on benzilated phenol, a beautifully white coloured crystalline body, not affected by air nor light, soluble in alcohol, ether, benzine, chloroform, and acetic acid, fuses at 84°, and boils at between 175° and 180°. On being analysed, this body gave results leading to the formula $C_{15}H_{12}O$. The products of the action of various reagents upon this body are described at length, and next benzilated anisol is treated on; this is a fluid boiling at 305°; sp. gr. at 0°—1·0729; miscible with alcohol and ether; formula, $C_{11}H_{14}O$. The action of hydriodic acid on this compound is lastly described at some length, the object being to ascertain whether the benzilated phenol directly obtained is identical with that produced from benzilated anisol by the action of the hydracid just alluded to; the result is identity of the two in all particulars.

Synthesis of Condensed Hydrocarbons.—D. Amato.—This essay treats at great length on certain hydrocarbons, C_nH_{2n}, obtained by the dry distillation of castor oil at temperatures varying from 200° to 320° and higher. Among the purified and analysed compounds thus obtained, the author found the following:—C_7H_{16} and $C_{11}H_{24}$, the former boiling at between 95° and 100°, the latter at between 180° and 185°; another, boiling at from 145° to 150°, in 100 parts—C, 81·7; H, 14·8; boiling at from 160° to 165°, in 100 parts—C, 81·5; H, 15·6; boiling at from 195° to 200°, in 100 parts—C, 82·6; H, 14·7.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, February, 1872.

This number does not contain any original papers relating to chemistry, but we call attention to—

Decree of the President of the French Republic Relating to the Warehousing and Wholesale and Retail Sale of Petroleum and Paraffin Oils, Benzoline, and other Essences and Hydrocarbons Used for Domestic or other Purposes.—The contents of this very well and clearly arranged measure of public safety deserve attention also for their practical applicability.

La Revue Scientifique de la France et de l'Etranger, March 16, 1872.

This number does not contain any original papers relating to chemistry.

March 23, 1872.

From a short account of the proceedings of the Chemical Society of Paris, held on the 15th of March last, and here published, we quote the following:—

Detection of the Presence of Nitrobenzol in Essential Oil of Almonds.—E. Bourgoin.—The author adds, to the essential oil of almonds to be tested, one-half of its weight of a solution of caustic potassa. When nitrobenzol is present the mixture becomes green-coloured.

Action of Metallic Silver upon Chloro-Iodide of Ethylen, C_2HCl.—Drs. Friedel and Silva.—The authors placed the compound alluded to along with metallic silver in a sealed tube heated to 160°, with the view to remove the iodine from two molecules of the chloro-iodide, and thus to obtain the normal chloride of butylen according to the formula $2(C_2H_4ClI)+Ag_2=2AgI+C_4H_8Cl_2$); but the reaction does not proceed so, since there is formed only iodide of silver, ethylen, C_2H_4, and chloride of ethylen, $C_2H_4Cl_2$.

Oxidation of Glycerine—Glyceric Acid.—Dr. Jungfleisch.—The author only observes, as regards Dr. Heintz's experiments in this direction, that the formic acid found by the last-named among the products of the oxidation alluded to is very likely due, not to the oxidation of glycerine, but to the dissociation of oxalic acid under the influence of glycerine at the temperature at which Dr. Heintz has experimented.

This number contains, moreover, the following memoirs, to which we call attention:—

The Sun and the Spots on it.—Dr. R. Wolf.—A very excellent paper on this subject containing a great many valuable historical details of phenomena seen on the sun in ages past.

The Jurassic Formation.—Dr. Neumayr.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, February 15, 1872.

This number opens with the first instalment of—

A Lecture on the Services which Chemistry has rendered to Agriculture.—Dr. Barral.—The author, having been appointed Perpetual Secretary to the Central Agricultural Society of France, instead of the late Dr. Payen, has taken this opportunity to enter upon his duties with a very excellent discourse on the subject just named.

New Method of Absorbing Sulphurous Acid Fumes.—M. Cahen.—The author suggests for this purpose the use of peroxide of manganese of low quality. The absorption of the sulphurous acid gas, including that evolved in metallurgical operations, is instantaneous; and if the ensuing manganese salts do not happen to be commercially of use they can be readily, by means of chloride of sodium, converted into hyposulphite of soda and other soda salts.

Improvements in Beet-Root Sugar Manufacture by Diffusion and Maceration.—M. Woestyn.—The description of a new method of operation invented by the author and successfully tried in Russia.

Detection of Acidity in Oils.—A. Rumpler.—The author first prepares chemically pure carbonate of soda, makes a concentrated aqueous solution of it, fills with that solution a test-glass, so as to form a layer of 26 m.m. in height, and next pours the oil to be tested on it and stirs the fluids thoroughly for a few moments. On being left quietly standing the oil should not, at the surface where it touches the soda, exhibit any greasy emulsion; if it does it contains acid, and if the quantity of the latter is somewhat considerable the whole mass becomes so thick that the glass can be turned upside down without the mixture flowing out.

Bulletin de l'Academie Royale des Sciences, des Lettres et de Beaux Arts de Belgique, No 2, 1872.

This number does not contain any original papers relating to chemistry.

Bayerisches Industrie und Gewerbe-Blatt, February, 1872.

This number does not contain any original papers relating to chemistry, but we mention the following subjects:—

Preparation of Meerschaum at Ruhla.—T. Urban.—The contents of this paper treat at length on the manufacture of the meerschaum pipes. It appears that meerschaum is an article of extensive trade, and is also met with in Asia Minor, the Crimea, Spain, and especially near Hrubschitz and Oslowan in Austria. Meerschaum, sepiolite, is a hydrated silicate of magnesia, lighter than water; some kinds of this mineral contain some alumina and oxide of iron.

Regulations to be Complied with for the Safety of the Steam-Boilers and other Steam Apparatus in the Kingdom of Bavaria.—In a very clear and concise manner, this official document sets forth everything which science and sound practice combined can do to render accidents with steam-boilers almost impossible, while no particular burden is thrown on the owners of the same.

NOTES AND QUERIES.

Steel Manufacture.—(Reply to "Early Subscriber.")—Consult the work on "Metallurgy" by the Editor of the CHEMICAL NEWS and Dr. Röhrig, and published by Longmans and Co.

Atmospheric Air.—Can any of your readers inform me on this point? If ordinary atmospheric air be passed through asbestos, is it freed from organic matter, sporules, &c., in the same manner as if passed through cotton-wool?—A SUBSCRIBER.

Water Pollution.—CHEMICAL NEWS of last week, p. 145, quotes 0·03 organic nitrogen as maximum impurity correctly from "Public Health Bill," but Rivers' Commission gives 0·3 of organic nitrogen. Probably 0·03 in the above Bill is a mistake for 0·3.—J. CAMPBELL BROWN, D.Sc.

Cement—Fractional Distillation.—(Reply to C. S.)—Dissolve caseine in a cold saturated solution of borax, and with this solution paste strips of hog's or bullock's bladder (previously softened in cold water) on to the cracks of the glass. After drying at a very gentle heat this will be found to answer your purpose; and if you want to apply heat to the glass vessel, coat the bladder on the outside before it is quite dry with a paste made of a rather concentrated solution of silicate of soda and quicklime or plaster-of-Paris; but it must be remembered that such a mixture becomes stone-hard, losing its plasticity in a very short time (from one-half to one or two hours, according to the degree of concentration of the silicate solution and the quantity of quicklime or plaster-of-Paris used. As regards the fractional distillation, you will find every information on this subject in "Encyclopédie-Roret. Couleurs d'Aniline d'Acide Phénique et de Naphtaline," vol. i., pp. 100 to 231; consult also the late Mr. Mansfield's papers, published in the *Journal of the Chemical Society*.

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MEETINGS FOR THE WEEK.

MONDAY, April 8th.—Medical, 8.
—— Anthropological, 8.
—— London Institution, 4. Mr. E. J. Hopkins, "On Music."
TUESDAY, 9th.—Civil Engineers, 8.
—— Photographic, 8.
—— Royal Institution, 3. Dr. Guy, "On Statistics and Social Science."
WEDNESDAY, 10th.—Society of Arts, 8.
—— Geological, 8.
THURSDAY, 11th.—London Institution, 7.30.
—— Royal, 8.30.
—— Royal Society Club, 6.
Royal Institution, 3. Dr. Tyndall, "On Heat and Light."
FRIDAY, 12th.—Royal Institution, 9. Mr. John Morley, "On Rousseau's Influence on Thought."
—— Quekett Microscopical Club, 8.
—— Astronomical, 8.
SATURDAY, 13th.—Royal Institution, 3. Mr. R. A. Proctor, "On Star-Depths."

TO CORRESPONDENTS.

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THE CHEMICAL NEWS.

VOL. XXV. No. 646.

ON PUTREFACTION.*

By Dr. F. CRACE CALVERT, F.R.S.

THIS paper is intimately connected with those I have already published on protoplasmic life and the influence of effects on putrefaction.

I have already shown that when albumen from a new-laid egg is introduced into *pure distilled water* and communication with the atmosphere prevented, protoplasmic life does not appear. If the same solution, however, be exposed to the atmosphere for fifteen to forty-five minutes, minute globular bodies appear having an independent motion, which I denominate monads. The time required varies according to the time of the year, the amount of moisture present in the atmosphere, and the temperature.

Although M. Pasteur has already noticed the meteorological conditions which influence that life, he has not noticed the extraordinary rapidity with which the fluids are impregnated, and that this impregnation is proportional to the surface exposed.

On the 18th of May, 1871, two portions of albumen, measuring 400 grains, were placed, the one in a test-tube having a diameter of $\frac{1}{2}$ inch, the other in a test-glass which at the surface of the liquid had a diameter of 2 inches. In the tube vibrios appeared after twelve days, whilst in the glass only five days were required for their development. If in place of pure distilled water the water supplied by the Manchester Corporation (which is one of the purest waters in England) be used, the time required for the development of vibrios in a test-tube was only twenty-four hours.

These experiments prove that the rate of development of vibrio life is influenced by the extent of surface exposed.

M. Pasteur has already demonstrated that oxygen is essential to the life of the Mucedines, but I am not aware that it has been proved that this gas is necessary to the existence of vibrio life.

In the hope of throwing some light on this subject, the following experiments were made:—

Into each of five glass bulbs equal volumes of a solution of albumen in Manchester water were placed, and the first left in contact with the atmosphere for twenty-four hours, after which the ends of the tube were hermetically sealed about 2 inches on each side of the bulb. After passing oxygen, hydrogen, nitrogen, and carbonic acid over the other four solutions, the tubes were also hermetically sealed. These tubes were kept closed for twenty-seven days, during which it was observed that the albumen in the bulb containing oxygen speedily became turbid, then the one containing air, while the other three remained clear. After this period the tubes were broken and the contents examined. A large quantity of vibrio life was found in those containing oxygen and common air, whilst those containing nitrogen, carbonic acid, and hydrogen contained very small quantities, that with hydrogen the least. Thus proving that oxygen is an essential element to the production of putrefactive vibrios.

In further support of this view, I may state that under certain conditions these animalcules produce such an amount of carbonic acid and other gases as to exclude oxygen to such an extent that their own development and life are impaired.

This is easily proved by taking albumen full of animalcules, but not emitting any putrid odour, and placing it in test-tubes, closing some and leaving others open. If these tubes are examined after a few weeks, it will be observed that in those left in the air life has much increased, and they emit a very putrid odour; whilst the life in the closed tubes not only has not increased, but appears to be in a dormant condition; for if the corks are removed and the fluid again comes in contact with the oxygen of the air, its activity returns. The albumen also in the closed tubes does not emit any putrid odour.

M. Pasteur has also found that oxygen was necessary to the vibrios of putrefaction, although the same gas destroyed those produced in butyric fermentation; but he has not made any experiments to show that the products emitted by such vibrios are prejudicial to their development, and even to their power of locomotion.

Having stated above that liquids exposed to the atmosphere become impregnated with monads, I will now try to describe their gradual development into vibrios, and their ultimate transformation into microzyma.

A few hours after the albuminous fluid becomes impregnated, the monads, which have a diameter of about $\frac{1}{12000}$th of an inch, appear to form masses. Then some of the monads become elongated into vibrios, which, though attached to the mass, have an independent motion; so that as the force exerted by the vibrios predominates towards one or another direction, so is the mass moved over the field of the microscope. As the development proceeds, the mass is broken up, and ultimately each vibrio has an independent existence, and may be seen swimming or rolling about in the fluid. Their size at this stage is about $\frac{1}{20000}$th of an inch. These, which I call ordinary vibrios, gradually grow into long vibrios, which attain a length of $\frac{1}{2000}$th of an inch.

These long vibrios gradually become changed into cells, which I have called microzyms. The first process in the transformation is its division into two independent bodies. One extremely faint line appears across the centre of the animalcule, and increases in distinctness until the vibrio appears like two smaller vibrios joined together. The separation takes place and each part acquires an independent existence. These parts again divide, and the process of subdivision is carried on until they appear to be nothing more than cells, which have a swimming-power so great as to pass over the field of the microscope with rapidity.

After twelve or eighteen months all the vibrios disappear and are replaced by microzyms, either in motion or at rest. If these microzyms are placed in a solution of fresh albumen, vibrios are abundantly developed. The apparent explanation of this fact is that in the fresh albumen they have all the circumstances favourable to their growth and reproduction, while the putrid albumen has become so completely modified as to be incapable of affording them the requisite conditions for reproduction.

I may also notice that at the same time a deposit has taken place which, under the microscope, appears to consist of shoals of small particles of matter which have no life. The solution has now become perfectly clear, possesses considerable refractive power, and has lost the property of becoming coagulated by heat.

The albumen solution does not emit a putrid odour until after the formation of the above-mentioned deposit, and the amount of odour is in direct ratio to the number of vibrios present.

I remarked during the investigation the presence of several other forms of animalcules which contribute to the decomposition and putrefaction of proteine substances, the description of which will be found in the original memoir.

* Abstract of a Paper read before the Royal Society.

THE REGISTRAR-GENERAL'S REPORTS ON THE LONDON WATERS.

By J. ALFRED WANKLYN.

PART II.

BEFORE leaving "Previous Sewage Contamination (Estimated)," which has figured in the Registrar-General's Reports ever since the beginning of the year 1867, it will not be amiss to glance at the use to which Dr. Frankland applied this datum.

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If the Reports issued in the earlier part of this period be inspected, as, for instance, the table for December, 1867, previous sewage will be found to be zero for Loch Katrine, Lancaster, Manchester, and Leicester, and to stand at 4820 for the Kent water, and at about 2000 for the water of the various Thames Companies. The Registrar-General also says, writing under date December 30th, 1867, "No previous sewage contamination occurred in the waters supplied to Glasgow, Lancaster, Manchester, or Leicester, but the London waters had been more or less contaminated previous to filtration." In fact, the return of Previous Sewage Contamination (Estimated) was connected with the attempt to force what was called pure water from the mountains on the Metropolis; and of late years, since that attempt was seen to be hopeless, the zeros for the Previous Sewage in Glasgow, Lancaster, Manchester, and Leicester have disappeared from the tables.

On comparing Dr. Frankland's Reports of the end of 1867 with Dr. Frankland's Reports of the present time, it will be seen that his analyses of 1867 led him to a conclusion the opposite of that which he now maintains. He used to find Kent water everything that is horrible, and once reported of it that "The use of this water for domestic purposes is very undesirable." Now, as chemists are amused to learn, writing December 28th, 1871, he finds that "if we call the amount of organic impurity in a given volume of the Kent Company's water 1, the proportional amount in an equal volume of water supplied by the other metropolitan companies was—New River, 2; Chelsea and Lambeth, 5·2, &c.;" and, in short, Kent water has now taken that position in his imagination that used to be occupied by the water of Loch Katrine.

Passing on to "organic carbon" and "organic nitrogen," the other novelties introduced into the Registrar-General's Reports, I will be very brief.

In the paper by Chapman, Smith, and myself, published by the Chemical Society in 1868, and never called in question by Dr. Frankland, there is a detailed account of our objections to these determinations of carbon and nitrogen in drinking waters. We have reprinted this paper in the appendix to the two editions of our little book on Water Analysis, in order that chemists intending to adopt Dr. Frankland's method may be warned of its difficulties. If it were certain that the organic matter in water underwent no decomposition during the evaporation of the water to dryness, if the nitrates could be utterly destroyed without damage to the organic matter, and if two or three milligrammes of organic substance were enough for an organic analysis, then Dr. Frankland's results might have some value.

The following table of the organic nitrogen given by the water of the Kent Company during the last four years is compiled from the official returns:—

Organic Nitrogen in 100,000 *parts of Kent Water.*

	1868.	1869.	1870.	1871.
January	0·013	0·013	0·013	0·014
February ..	0·013	0·010	0·010	—
March	0·029	0·017	0·008	0·010
April	0·011	0·012	0·008	0·005
May	0·006	0·008	0·018	0·011
June	0·007	—	0·017	0·007
July	0·009	—	0·009	0·010
August	—	—	0·019	—
September ..	0·007	—	0·017	0·008
October	0·006	—	—	0·012
November ..	0.026	—	0·005	0·013
December ..	0·012	—	0·019	0·008

I was unable to procure the returns for the latter part of 1869, which will explain the occurrence of blanks for that year. For the rest, the blanks exhibited in the above are likewise to be met with in the official return.

Now, it is extremely unlikely that the quality of the Kent water has altered during the last four years, yet we find a variation of from 0·007 to 0·029 in 1868, from 0·005 to 0·019 in 1870, and from 0·005 to 0·013 in 1871. During the whole of this period the Kent water has no doubt been constantly purer than the Thames waters, or than New River water; and yet in March, 1868, the organic nitrogen in it was found higher than in two of the Thames' Companies, or in East London water, or in New River water. In November of the same year, Lambeth water was highest (viz., 0·027 of organic nitrogen), then came Kent water, 0·026, and after it the notorious Southwark and Vauxhall and all the other companies.

ON METASTANNIC ACID AND THE DETECTION AND ESTIMATION OF TIN.*

By ALFRED H. ALLEN, F.C.S.

METASTANNIC ACID is generally stated to be insoluble in ordinary acids, though some writers describe it as forming compounds with sulphuric and hydrochloric acids. My results are greatly at variance with the described characters of metastannic acid, as will be seen from the following observations.

Metastannic acid was prepared by oxidising tin by nitric acid, and washing thoroughly by decantation and on the filter. The product was boiled with concentrated hydrochloric acid (sp. gr. 1·11) for some minutes, the liquid decanted from the residue and tested by hydrosulphuric acid. The liquid in every case contained abundance of tin, and when much hydrochloric acid was employed the solution was sometimes nearly perfect. The residue possessed the properties attributed to it by Miller and Fresenius, but its aqueous solution showed far less liability to precipitation by excess of acid than I had expected. Any method of analysis depending on the insolubility of metastannic acid in hydrochloric acid must be utterly worthless.† The presence of stannic phosphate or arseniate in no way alters the solubility of metastannic acid, but renders the solution liable to precipitate on addition of water, especially when heated. The residue left when antimony has been oxidised by nitric acid is perfectly soluble in hydrochloric acid, but of course the solution is very readily precipitated by dilution.

Metastannic acid readily and completely dissolves when heated with concentrated sulphuric acid, becoming converted into *ordinary* stannic sulphate, $(Sn''''(SO_4)_2)$. If the liquid be poured into cold water, a solution of stannic sulphate is at first obtained, but this quickly deposits some of the tin as *ortho*-stannic hydrate. On boiling the solution of stannic sulphate, the whole of the tin is precipitated as metastannic acid.

Ignited and native stannic oxides are not completely dissolved by hot strong sulphuric acid. Fusion with acid sulphate of potassium acts on them more or less perfectly, and the aqueous solution of the product contains stannic sulphate, giving a precipitate of metastannic acid on boiling. The reaction presents the closest analogy to the decomposition of titanic sulphate by dilution and boiling.

On adding about twice its bulk of hydrochloric acid to the solution of metastannic in sulphuric acid, a solution is formed which will bear considerable dilution without suffering precipitation. This liquid corresponds in every respect to a solution of *ordinary* stannic chloride, and is free from *meta*-chloride.

The residue left on oxidising antimony by nitric acid is readily acted on by strong sulphuric acid; but the solution produced by subsequent treatment with hydrochloric acid is very readily precipitated by water. Of course this can be avoided by addition of tartaric acid. Ignited Sb_2O_4 is not dissolved by heating with sulphuric acid.

* Abstract of a Paper read before the Chemical Society, March 7, 1872.

† Fresenius makes use of the supposed insolubility of metastannic acid in hot concentrated hydrochloric acid in his method of "Qualitative Analysis" (7th edition, p. 110).

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On making the observation that ordinary stannic sulphate was formed when metastannic acid was heated with concentrated sulphuric acid, the value of the reaction for analytical purposes became at once apparent.

The reaction is especially serviceable in analysing the residue left on dissolving alloys in nitric acid. The following are the details of the method I prefer for the purpose:—

The residue is washed, and heated with concentrated sulphuric acid in moderate quantity until copious fumes of the acid are evolved. The liquid, which should be quite clear, is allowed to cool, and is then treated with two or three times its bulk of concentrated hydrochloric acid, and boiled if not still perfectly clear. The solution is diluted with about an equal bulk of water, and is then ready for examination. Estimation of the metals can be effected by the usual processes. For their detection, I have found the following method preferable. The solution is divided into several portions.

(1). Is tested for antimony with zinc in a platinum vessel, or by heating with a fragment of metallic tin (this precipitates copper also, if present).

(2). Is diluted and tested for iron and copper by potassium ferrocyanide.

(3). Is diluted, treated with tartaric acid, excess of ammonia and "magnesia mixture," stirred, left some hours, and the sides of the vessel carefully examined for streaks of ammonio-magnesium phosphate or arseniate; these, if detected, may be readily distinguished by the method described by me in CHEMICAL NEWS, vol. xxiv., p. 120. Small quantities of arsenic are difficult of detection by magnesium, owing to the solubility of the ammonio-magnesium arseniate in ammoniacal liquids. Direct application of the molybdic acid test to the acid liquid often indicates the phosphate or arseniate when present, but is not to be relied on.

(4). The solution is boiled (without dilution) with a few inches of soft iron wire until colourless. It is then diluted with about two parts of water, and again heated for a few minutes. By this means the tin is completely or partially reduced to the stannous condition, without being precipitated in the metallic state as when zinc is used; the solution decanted from the precipitated antimony (and copper), and the tin at once detected by mercuric chloride (which is not reduced by ferrous chloride), or the brown stannous sulphide may be precipitated by hydrosulphuric acid. Mere traces of tin may be detected in this manner.

The action of nitric acid on alloys of tin and gold produces a beautiful purple residue, which owes its colour to purple of Cassius. This residue, when heated with concentrated sulphuric acid, gives a purple solution, which, on further heating, becomes colourless, the whole of the tin being dissolved and the gold remaining as a heavy brown metallic residue. The purple residue was always washed free from nitric acid. If hydrochloric acid be added before the purple solution has turned colourless, a small quantity of gold remains in permanent solution, probably as chloride. As a precaution against this source of error, if the solution has any yellow tint after addition of hydrochloric acid and an equal bulk of water, it is well to boil with a crystal of ferrous sulphate, which reduces the gold without affecting the stannic solution.

I had hoped from these results to obtain some insight into the obscure constitution of purple of Cassius. If we suppose it to contain $Au_2O_3,3SnO,+4H_2O$, the fact of a purple liquid being formed with sulphuric acid is difficult to understand if the oxides are merely converted into sulphates, as neither auric nor stannic sulphate has a deep colour, and they could scarcely co-exist in a liquid.

If the purple be regarded as containing aurous and stannous stannate ($Au_2'SnO_3,Sn''SnO_3+4aq$), the action of sulphuric acid would probably result in the formation of aurous, stannous, and stannic sulphates—

$$(Au_2'SO_4+Sn''SO_4+2Sn''''(SO_4)_2);$$

and at a higher temperature the two first products might easily react to form metallic gold and stannic sulphate, which are undoubtedly the ultimate products.

I have recently shown that auric sulphate is more stable than had been supposed, and, although aurous sulphate has never been obtained, it may possibly exist, and possess a purple colour like the aurous stannate believed to be present in purple of Cassius. Aurous oxide is stated by Figuier to have a violet colour, and to combine with acids. I do not think the purple colour of the sulphuric acid solution can be due to metallic gold in suspension. On dilution with water, the purple is gradually deposited in an apparently unchanged state.

I have found the sulphuric acid method very serviceable for the qualitative and quantitative analysis of dentists' alloys containing gold, silver, and tin. After treating with nitric acid, and thus obtaining the silver in solution, the purple residue is acted on by sulphuric and hydrochloric acids as before described, the gold being weighed direct and the tin estimated by one of the ordinary methods. For this purpose, I prefer to neutralise the free acid, add a moderate excess of sulphuric acid, dilute largely, and boil, when the whole of the tin is thrown down as a white precipitate of metastannic hydrate, which can be readily filtered and washed, and on ignition leaves pure SnO_2.

The purity of the gold was ascertained by dissolving in bromine water, which in every case effected complete solution.

By the above method, all residues left by the action of nitric acid on alloys can be rapidly and accurately analysed in the wet way, thus avoiding all processes of ignition or fusion.

Sheffield, February 16, 1872.

THE STATE OF COMBINATION OF SILICIC AND CARBONIC ACIDS IN WATER.*

By EDWARD NICHOLSON, Assist. Surg. R.A.,
Analyst of Waters, Mysore, Northern, and Ceded Districts.

IT is generally assumed that in a natural water all the bases not combined with sulphuric acid, chlorine, and nitric acid, are in the state of carbonates, probably as bicarbonates in the case of potassium and sodium, certainly so in the case of calcium and magnesium. In the statement of analyses, when a formula is given for the saline combinations considered to be present, it is usual to leave silica and alumina uncombined; iron is also often left uncombined, as peroxide, though it is sometimes shown combined either as ferrous carbonate or as ferric phosphate. The reason of this hesitation regarding silica and alumina, is that the amount present in the waters of Europe is generally so small that it is considered not worth while risking a hazardous formula in the case of constituents of such doubtful status. The quantity of silica found in waters of the continent of Europe rarely exceeds 5 centigrms. per litre†, except in the case of three or four mineral springs; and in England the quantities recorded are still smaller. As an example of a calcareous water, that of the river Thames, according to two standard analyses, contains 1·01 to 1·13 centigrms. per litre; the waters of the rivers Don and Dee, in a granitic district, contain 4·85 and 0·20 centigrm. per litre, respectively. Alumina has rarely been noted in English waters in any quantity above a trace; in some continental waters, and in some chalybeate springs, it has been found in larger quantity.

But in Indian waters, silica is by no means an insignificant constituent, and it is probable that few waters are

* Reprinted from the *Madras Monthly Journal of Medical Science* for December, 1871.

† The centigramme is a more convenient unit than the grm. for water analysis; 10 centigrammes (0·1000 grm.) per litre are equal to 7 grs. per gallon.

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free from it. In the analyses recorded in the Bengal reports, the silica given must always be rather under the real quantity, as it is apparently estimated in the insoluble part of the residue of evaporation, or even in the deposit produced by boiling; yet it is always stated to be present, and the quantity given is often as much as 8 or 10 centigrms. per litre; in one case as much as 16 centigrms. is recorded. In Bangalore waters I have met with as much as 8 centigrms. per litre.

Alumina is also rarely absent from Indian waters; I have frequently found as much as 2 centigrms. per litre.

Now silica (silicon dioxide or silicic anhydride) is all but completely insoluble in water, whilst its hydrate, silicic acid, is soluble to a considerable extent though unstable, and some of the metallic silicates are also soluble and, moreover, stable. If we found only traces of silica in water its condition might be doubtful, but when we find that quantities of 8 centigrms. per litre, and upwards are by no means uncommon, and that such waters are capable of concentration to any extent without the solubility of the silicon compound being much impaired, then it is evident that the silicon cannot be present in the form of the insoluble oxide which we extract during analysis. Neither is it in the form of free silicic acid, as this substance, though of considerable solubility, is unstable and a *colloid*, whilst the silicon compound present in water is but little affected in solubility by repeated evaporation and ignition, and passes perfectly through a dialysing medium. It must therefore be as a soluble silicate that the silica we find was present in water. In order to determine the condition and properties of this silicate, I made the following experiments on a water of very constant composition, that of the Dhobies' wells at Bangalore, containing, as a mean of analyses at various times, the following mineral constituents:—

	Centigrms. per litre.
Sodium	4·37
Potassium	0·42
Magnesium .. 0·56 to 0·77. mean	0·66
Calcium	3·17
Aluminium (traces of iron)	0·35
Chlorine	3·75
Sulphuric acid, SO_4,	0·72
Nitric acid, NO_3,	0·01 (maximum)
Phosphoric acid, PO_4	0·11
Silicic acid, SiO_3	4·34 (SiO_2 3·43)
Carbonic acid, CO_3, and loss	7·10
Mean residue of evaporation	25·00*

These constituents were divided into "soluble" and "insoluble" in four different ways, and in each case the total solids, the silicic acid, the aluminium, the calcium, and the magnesium were determined separately in the deposit and in the solution. The results are given in the following table:—

	A. Evap. to ¼ in an open vessel.		B. Evap. to 1-15th in a closed vessel.		C. Evap. to 1-30th in a open vessel.		D. Evap. to dryness and ignition in an open vessel.	
(Centigrms. per litre). ..	Deposit.	Solution.	Deposit.	Solution.	Deposit.	Solution,	Deposit.	Solution.
Total solids	13·71	10·29	11·46	14·77	10·43	15·14	13·57	12·00
Percentage	57	43	43	57	40	60	53	47
Silicic acid	0·10	4·33	0·06	4·26	2·08	2·17	3·89	036
Percentage	2	98	1	99	49	51	91	9
Aluminium	0·11	0·26	?	0·01	Not determined.		0·34	none
Percentage	30	70	97?	3?			100	0
Magnesium	0·04	0·72	0·55	0·01	0·67	0·10	0·76	0·01
Percentage	5	95	98	2	87	13	99	1
Calcium	2·86	0·37	3·00	0·07	2·97	0·20	3·03	0·04
Percentage	88	12	98	2	94	6	99	1

The evaporation marked B was by far the most interesting experiment, as the influence of atmospheric carbonic acid was excluded; the deposit and the concentrated water were made the subject of further experiment.

The deposit during evaporation consists of two parts; one firmly adhering to the sides of the vessel, and consisting principally of calcium carbonate; the other of much looser consistence and readily detached. This latter portion, as obtained in evaporation B, showed the following composition in 100 parts—

Magnesium	3·78
Calcium	15·23
Aluminium	8·55 (with some iron).
Phosphoric acid	0·98
Silicic acid	46·86
Carbonic acid and loss	24·28
	100·00

These constituents may be combined as follows:—

Aluminium phosphate	1·26
Aluminium silicate	42·50
Magnesium silicate	16·62
Calcium carbonate	38·07
	98·45

This deposit is evidently formed subsequently to the hard deposit of calcium carbonate, and consists principally of the less soluble silcates deposited gradually during evaporation.

The concentrated water obtained in evaporation B was found to contain 228·71 centigrms. of mineral solids per litre, and only retained a small amount of earthy salts, giving a hardness of 1·43° (=1·43 centigrms. of calcium carbonate per litre).

Four ounces ($\frac{1}{10}$ gallon) of it were evaporated to dryness; towards the end of the evaporation, a tough flexible pellicle formed on the surface, but there was no appearance of gelatinous silicic acid. The residue, after being ignited in order to expel the notable amount of organic matter,* weighed 4·00 grains (=228·71 centigrms. per litre). Treated with boiling distilled water it dissolved, with the exception of 0·26 grain; this insoluble residue was found to contain—

Silica	0·240 grain
Calcium	0·012
Magnesium	traces
Aluminium	0·004

This evaporation and re-solution of the residue was repeated three times, and each time there was left a small insoluble residue of the same character as the first, the quantity of calcium, &c., diminishing, however, to mere traces. The quantities of silica obtained were—

* For the formula of the combinations of these constituents see at the end of this paper.

* Boiling a water does not rid it of organic matters: it is probable that suspended organic matters only are carried down in the calcareous precipitate.

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	Grs.	Centigrms. per litre.
First evaporation	0·240	13·71
Second ,, ...	0·180	10·28
Third ,, ...	0·170	9·71
Fourth ,, ...	0·085	4·85
Remaining in solution after four evaporations	0·240	13·71
Total silica present.. ..	0·915	52·26

It is evident that the 38·57 centigrms. per litre, equal to 74 per cent of the whole amount, remaining in a soluble condition after the first evaporation and ignition, must have been in the condition of an alkaline silicate, and that its gradual elimination by repeated evaporations and ignitions was owing to the decomposing effect of atmospheric carbonic acid.

Four ounces ($\frac{1}{10}$ gallon) of this concentrated water were dialysed for two days, the distilled water being changed twice; evaporation gave a residue of 0·070 grain, of which 0·025 grain was silica; 0·890 grain of silica had passed therefore through the dialyser, leaving only 2 per cent. This confirms the evidence that a soluble silicate, and not free silicic acid, was present in the concentrated water.

On comparing the results of these evaporations of the water concentrated in B with the evaporation D, it will be observed that in the former case no less than 74 per cent of the silicic acid remained soluble after ignition of the evaporated residue, while in evaporation D only 9 per cent remained soluble after the same treatment. The reason of this is that in the latter experiment the alkaline silicate was evaporated to dryness, and ignited in the presence of a deposit of calcium carbonate; consequently, insoluble silicate of lime was formed, leaving carbonate of soda in the soluble portion; while the water concentrated in evaporation B was evaporated without access of atmospheric carbonic acid,* and the evaporation was completed and the ignition performed after removal from the deposit of calcium carbonate. The decomposing effect of atmospheric carbonic acid, and of the calcareous deposit, is shown also in evaporation C; this having been done with access of air, in presence of the calcareous deposit, and also being pushed further towards dryness, we find that only 51 per cent of silicic acid remained in solution, instead of 99 per cent as in evaporation B.

When the concentrated water of evaporation B was evaporated to dryness after addition of some artificial calcium carbonate, the amount of silicic acid recovered by treatment with boiling distilled water was only 45 per cent instead of 74 per cent, this addition assimilating the evaporation in a great measure to that made in experiment D under the influence of the natural calcareous deposit. We find, then, that the effect on the silicic acid of evaporation in presence of calcium carbonate may be stated thus:—

	Silicic acid become insoluble, per cent.	Silicic acid remaining soluble, per cent.
Water concentrated to $\frac{1}{5}$, evaporated and ignited after separation of the calcareous deposit	26	74
The same, but evaporated and ignited in presence of artificial calcium carbonate	55	45
Water evaporated and ignited without separation of the calcareous deposit	91	9

In all these cases, both the original water and the solution of the evaporated residue had an alkaline reaction, the original water containing earthy carbonate and both earthy and alkaline silicates, and the solution of the evaporated residue containing alkaline silicate and carbonate.

The following conclusions may be drawn from these experiments:—

1st. The silica found in the analysis of waters was present as silicic acid combined with basic metals, generally sodium, magnesium, and aluminium.

2nd. These three silicates, alkaline, earthy and aluminous, differ in solubility; the aluminium silicate is the least soluble, and begins to be deposited when evaporation has concentrated the water by a quarter or a half; magnesium silicate is deposited only towards the end of the evaporation; sodium silicate is of perfect solubility, and remains in solution to the last.

3rd. The sodium silicate is, however, liable to decomposition from two causes; atmospheric carbonic acid eliminates the silicic acid slowly during evaporation, and the deposit of calcium carbonate which takes place in nearly every water enters with it into a mutual decomposition, having for result the formation of insoluble calcium silicate and of soluble carbonate of soda.

4th. The evaporation of a calcareous water may be divided into the following stages:—

First.—Expulsion of carbonic acid gas, causing the precipitation of the insoluble substances which it held up—calcium carbonate, magnesium carbonate,* aluminium or ferric phosphate, ferrous carbonate.

Secondly.—Gradual deposit of slightly soluble substances as the water becomes supersaturated with them; aluminium silicate, magnesium silicate, calcium sulphate, are thus successively deposited.

Thirdly.—Reaction of the precipitated calcium carbonate on the sodium silicate in solution, the silicic acid becoming replaced by carbonic acid.

Fourthly.—Final evaporation to dryness, causing the crystallisation of alkaline chlorides or sulphates, and of any alkaline carbonates that may exist naturally or may have just been formed; deposit of any alkaline silicate that has escaped decomposition, and of any soluble earthy salts.

Fifthly.—Sodium carbonate may be present naturally in a water, usually as bicarbonate, before evaporation. In a concentrated water it must of course be as carbonate; the loss of its second atom of carbonic acid is often testified by the soapy feel and smell which the water acquires. Its presence is incompatible with that of any earthy salts but carbonates; for instance, calcium sulphate cannot be present, because calcium carbonate and sodium sulphate will inevitably be formed in consequence of the actual or potential insolubility of the former, and the much greater affinity of the strong acid radicals for the alkaline metals than for the earthy metals. Conversely, if a water which has been well boiled, or the solution obtained by washing the residue of evaporation of a water, shows a greater hardness than that ascribable to the small quantity of earthy carbonates or silicates still in solution—no alkaline carbonate can be present. Water will retain as much as 2 or 3 centigrms. of calcium carbonate per litre after boiling, and the magnesium carbonate or silicate may amount to as much more, so that a water may have a "permanent hardness" of six degrees or perhaps more, without containing any earthy sulphates, nitrates, or chlorides.†

But if instead of simply boiling the water it be evaporated to dryness and the residue treated with hot distilled water sufficient to dissolve the soluble earthy salts, the sources of error are eliminated, and a hardness

* More properly carbonic anhydride.

* Magnesium carbonate is somewhat soluble; when in small quantity it remains in solution, often becoming changed into silicate at the end of the evaporation.

† However worthless be the results of the soap-test in unpractised hands, there is no doubt that if used with ordinary skill, it affords rapid and fairly accurate information as to the amount of earthy metals present in dilute solutions. The best graduation is that of 1°=1 centigrm. of calcium carbonate per litre.

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of more than 1 degree (calculated on the original volume of the water) shows with certainty that earthy sulphates, chlorides, or nitrates are present. Waters absolutely free from those salts do not show more than one or two-tenths of a degree of permanent hardness if it be determined in this way.

From this incompatibility of sodium carbonate with earthy sulphates, &c., we may deduce that sodium silicate is also incompatible with them, and it may be taken as a rule that waters containing earthy sulphates, nitrates, or chlorides, contain no sodium carbonate or silicate, and that the residue of evaporation (this being necessary in order to eliminate earthy carbonates) will show but feeble alkaline reaction. In these waters the silicic acid must be combined with aluminium or magnesium (or calcium ?). There can be no mistake on this point in working out the formula of a water from its analysis, as waters of permanent hardness will always contain a quantity of sulphuric acid, nitric acid or chlorine, much in excess atomically of the amount of alkaline metals present.

Sixthly.—When the residue of evaporation of a water is divided, by washing, into soluble and insoluble salts, the result is by no means constant. We have seen that 9 per cent of the silicic acid may still remain soluble; a portion of the insoluble silicic acid may be present as silica, having been eliminated by atmospheric carbonic acid, whilst another portion is in the form of calcium silicate formed by double decomposition. Practically, though the amount of residual mineral solid is very fairly constant in a water exempt from earthy chlorides or nitrates, the division of these solids into "soluble" and "insoluble" by treatment with water does not afford very constant results. Two determinations, made under the same circumstances as far as possible, will differ by as much as 1 or 2 centigrms. per litre. This separation of the residual mineral solids into "soluble" and "insoluble," however useful in purely hygienic examinations, and as a check in working out the formula of a water, cannot be taken as the basis of an analysis.

Seventhly.—Until some practical method of estimating carbonic acid can be made available for ordinary use, there will always be some difficulty in working out with certainty the formula of a water. The difficulty in working it out with the carbonic acid estimated differentially, would be very great if the soluble combinations of silicic acid were as complicated as its natural insoluble combinations. Fortunately they are not, and I believe that when the subject has been fully investigated, it will be found that the natural soluble silicates are simple in composition.

Eighthly.—From the above experiments it is, I think, evident that the terms "silica" and "alumina" should be dropped in statements of analyses, and that "silicic acid" and "aluminium" should be used as in the case of the other acid and basic radicals. The question then arises, how is silicic acid to be represented, soluble silicic acid being H_4SiO_4, whilst silicon dioxide is SiO_2? The annexed table of the oxygen derivatives of silicon, with those of the other elements of the group carbon, boron, and silicon, will, I hope, explain this point satisfactorily. It will be seen that, like the ortho-borates, the ortho-silicates are dehydrated by heat, and ortho-silicic acid, H_4SiO_4, becomes H_2SiO_3, meta-silicic acid; the acid radical should therefore be represented in analysis by SiO_3. Having worked out the formula of a number of analyses both of my own and amongst those published by European chemists, I find that the silicates found in water are not usually of other than simple composition. I would direct the attention of analysts to the subject; but as far as I can see at present, I believe that the silicates we find in water may, when dehydrated, be represented in the same way as the salts of any other acid derived from a dyad radical, thus:—

$$Na_2SiO_3—MgSiO_3—Al_{23}SiO_3$$

in the case of a monovalent; a divalent, and a trivalent metal respectively.

It is on the basis of this assumption that I have arranged the formula of the water used in the foregoing experiments and the radical constituents of which have been detailed. It will be seen that the total agrees very fairly with the quantity of mineral residue left on evaporation; the difference is owing partly to the loss which must inevitably occur in the analysis of such dilute solutions, and partly to the absorption of atmospheric carbonic acid by the alkaline silicates during the process of evaporation. But, *per contra*, in an analysis calculated as usual with all the silicates decomposed into silica and carbonates, there will be generally a considerable surplus on the total of the constituents calculated over the mineral residue obtained by evaporation. The quantities found in this analysis yield the following formula:—

	Centigrms. per litre.
Sodium chloride	6·17
Sodium sulphate	0·26
Potassium sulphate	0·96
Sodium silicate	4·93
Aluminium phosphate	0·14
Aluminium silicate	1·64
Magnesium carbonate	2·31
Calcium carbonate	7·92
Total	24·38

The total shows a loss of 0·67 centigrm. on the mean total residue (25·00 centigrms.) found by evaporation, but if the formula were calculated in the usual manner, with silica, alumina, and phosphoric acid uncombined, and carbonic acid gratuitously bestowed on the basic radicals not provided with chlorine and sulphuric acid, the total would show no longer a loss, but a gain of 1 centigrm. on the total residue found by evaporation. It was this gain against all probability that first awakened my suspicions of the correctness of the usual calculations.

Comparative Table of the Oxygen Derivatives of the Natural Group Carbon, Silicon, Boron.

Carbonic anhydride, CO_2. (Carbon dioxide).	Silicic anhydride, SiO_2. (Silicon dioxide).	Boric anhydride, B_2O_3. The following modifications of boric acid may be considered as successive combinations of boric anhydride (2 atoms), with 1, 2, 3, and 6 atoms of water.
	Pyrosilicic acids. Pyrosilicates of the types $H_2Si_2O_5$ and $H_4Si_3O_8$ may be considered as existing in certain felspars.	Pyroboric acid, $H_2B_4O_7$. Fused borax $Na_2B_4O_7$ may be considered as salt of this hypothetical acid.
Carbonic acid, H_2CO_3.	Metasilicic acid, H_2SiO_3. May be considered as existing in dry sodium silicate, Na_2SiO_3.	Metaboric acid, HBO_2. Neutral borax is $NaBO_2$.
		Tetraboric acid, $H_6B_4O_9$. (Hypothetical).
	Orthosilicic acid, H_4SiO_4. (Soluble silicic acid). Sodium silicate in solution may be considered as $H_2Na_2SiO_4$.	Orthoboric acid, H_3BO_3. Ordinary borax may be considered as $H_5Na_2BO_8$.

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TESTING INDIGO.

By J. M. MERRICK, S.B.

In Sutton's "Systematic Handbook of Volumetric Analysis (ed. 1863, p. 179), a paragraph occurs which has always seemed to me calculated to mislead beginners, viz., "Schlumberger's method consists in adding the indigo solution . . . . to a measured quantity of solution of chloride of lime, the strength of which has just previously been determined by a solution of pure indigo-blue; *but as this is a most expensive and rare material, and must be used for almost every analysis, the process will not be further described.*" The statement in italics is incorrect. Pure indigo-blue, to be sure, is expensive—is advertised in French catalogues at 1 fr. 50 c. per grm.; but it is not difficult to prepare, and need not be used for every analysis.

An excellent plan is to prepare some indigo-blue of perfect purity, dry it for some hours at 100° C., and then determine accurately the per cent of blue in a choice sample of Bengal blue; which afterwards can be kept as a standard, and by a simple process, the percentage value of any other indigo obtained.

I have always found a weak solution of potassic permanganate preferable to a solution of chloride of lime for testing indigo and cochineal. It does not precipitate the colouring or other matters from the solution, and gives, I think, sharper readings.—*American Chemist.*

SPONTANEOUS COMBUSTION.

In March last, a well-known Detroit druggist, assisted by two seriously inclined and science-loving gentlemen, resolved to make a number of experiments to test the worth of the talk about spontaneous combustion, and their experiments are well worth the attention of every reader.

They first took a piece of cotton cloth, which had once formed part of a sheet, and which had been used until quite threadbare, and smeared it with boiled linseed oil. An old chest was placed in the loft of a store-room back of the drug store, a piece of zinc over it, another piece under it, and then the chest filled with paper and rags, and this particular piece of cloth placed in the centre. Although the room was not a light one, and the weather cold, in eight days there was such a smell of fire about the trunk, and the chances were so good for a conflagration within it, that the contents were emptied.

An examination showed that the fibre of the oil-cloth had untwisted and shrivelled up, and that the rag looked as if it had been held too near a hot blaze. In April, when the rays of the sun were stronger, a pair of painter's overalls, literally covered with paint and oil, were rolled up, a handful of pine shavings placed inside, and these were crowded in next to the roof boards of the loft. The experiment was not a week old when, during one warm afternoon, a smell of smoke alarmed a workman in the next room, and he found the overalls burning, and so tinder-like was the cloth that it had to be crowded into a pail of water to prevent total destruction.

During the hot weather of August, a handful of old cotton rags, in which two matches were placed, but which were not smeared with oil or other matter, were shut up in a tin box, and hung up in the loft, a rear window allowing the afternoon sun to shine directly on the box for several hours. Toward the close of the fourth day the druggist took down the box to see how the experiment was progressing, and found the contents to consist of nothing but a puff of black cinders, which flew all over him as the lid was lifted. Having a vacant corner in his brick wood-house at home, the druggist took the trunk up there, where there was no danger of burning a building. He filled the trunk with the contents of the paper rag-bag, and then smeared one with benzine and threw it in last of all. The trunk was shut tight, everything cleared away from its vicinity, and he commenced watching. One day the family came home to find a few ashes marking the place where the trunk stood, while the bricks above and around were badly stained with smoke.—*Scientific Press.*

ON BENDING GLASS TUBES FOR FITTING APPARATUS.

By J. LAWRENCE SMITH.

It is well known that it requires some tact to bend a tube with an even curve and without collapsing its sides, and many chemists never do succeed in bending them skilfully. Although having no particular skill in this matter, I never fail to bend them perfectly satisfactorily, by using a flame different from the one usually employed; the flame is one given by the Bunsen burner described in my article on alkali determination in silicates. (See Chemical News, vol. xxiii., p. 235). The burner is very commonly used now in all laboratories, where the extremity of the burner is flattened out so as to give a short and thin but broad flame, something like the flame of an ordinary gas-burner. The tube is placed in this flame and turned round and round, until a good heat is given to the tube; it is then withdrawn from the flame and bent, when it does so with a perfect curve and no collapse of the sides of the tube. Of course this is only intended for the smaller tubes, but a tube of 1 centimetre and more can be thus bent very readily.—*American Chemist.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, April 4th, 1872.

Dr. Frankland, F.R.S., President, in the Chair.

As soon as the minutes of the previous meetings had been read, the following gentlemen were formally admitted Fellows of the Society:—Messrs. E. N. Butt, John Ruffle, Thomas Greenish, and Edward Smith.

The names of candidates read for the first time were those of Messrs. Richard Anderson and George Cordwent.

For the third time—Messrs. William Frederick Donkin, B.A. Charles D. Hunter, Reynold Le Neve Foster, Alexander Noble, W. Little, and William Henry Walbourne, who were afterwards balloted for and declared duly elected.

The President then called on Dr. Schorlemmer, F.R.S., to deliver his lecture on "*The Chemistry of the Hydrocarbons.*" After briefly sketching the history of the division of chemical science into the two branches of inorganic and organic, the lecturer mentioned that, although Gmelin had previously called attention to the presence of carbon in all organic compounds, Kekulé was the first who distinctly advocated the view that organic chemistry should be considered as the chemistry of the carbon compounds, and in this he has since been very generally followed. The hydrocarbons are not only the most simple of the carbon compounds, but most important from a theoretical point of view, as all other carbon compounds may be regarded as derivatives of them, that is, as being formed by a replacement of their hydrogen by other elements or groups of elements, so that we may define organic chemistry as the chemistry of the hydrocarbons and their derivatives. The first hydrocarbons considered were the paraffins, which have the

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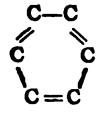
general formula C_nH_{2n+2}, and in which the tetrad-carbon atoms are linked together, the free combining capacities of such a group being saturated by hydrogen, so that their most characteristic property is, that they are not capable of uniting with other bodies. The lecturer then noticed the two assumptions which had been made to account for the isomerism occurring in this group, namely, that founded on the supposed difference in function between the four combining affinities of the carbon atom, and the generally received one of the different grouping of the carbon atoms. The paraffins may be divided into four groups. (1) The normal paraffins, in which each carbon atom is united directly to at most two others. (2) Those in which it is directly united to three others, or which contain the group isopropyl. (3) Those containing the isopropyl group twice. (4) Those in which one carbon atom is combined directly with four others.

By subtracting two atoms of hydrogen from the paraffins we obtain the second group of hydrocarbons, called by Guthrie the olefines, which, although they closely resemble the paraffins in their physical properties, are readily distinguished from them by the energy with which they combine with the haloid elements. In respect to their constitution they may be regarded either—(1) as containing carbon atoms with free combining units; (2) as having one of the carbon atoms a dyad instead of a tetrad; or (3) as having one carbon atom linked to the other by two combining units. The great bulk of evidence is in favour of the latter view, namely, that they are really saturated compounds containing two carbon-atoms linked together by two combining units of each,—ethylene, $H_2C=CH_2$. The polyolenes were then discussed with especial reference to the constitution of diamylene, the only member of this group which has been carefully studied.

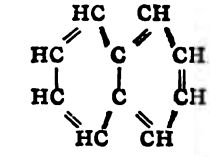
The hydrocarbons of the acetylene series are formed by abstracting 2 atoms of hydrogen from the olefines; the general method of effecting this being to remove two molecules of hydrobromic acid from the corresponding olefine dibromide. In acetylene, C_2H_2, the first member of this series, the two carbon atoms are linked together by three combining units of each atom HC≡CH, and its homologues may be regarded as derived from it by substitution of a monad alcohol radical for 1 atom of hydrogen.

The hydrocarbons of the series C_nH_{n2-4}, of which only two have as yet been prepared artificially, includes the very large number of hydrocarbons called terpenes found in plants. These possess the property of being easily converted into new isomeric modifications, which may again be changed into new isomerides, but all yield at the end one and the same product, called *terebene*, whose most characteristic property is that it forms a hemi-hydrochloride, $(C_{10}H_{16})_2HCl$. On oxidising terpenes terephthalic acid is always found amongst the products, and as this acid is also formed in a similar manner from certain aromatic hydrocarbons, it is highly probable that these two series are nearly related.

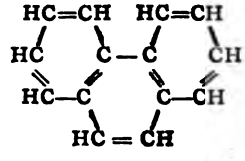
Aromatic Hydrocarbons.—In this group the following points may be noted:—(1) That they all contain a common nucleus consisting of six atoms of carbon. (2) These six atoms are linked together by one and two combining units alternately, thus leaving six combining units non-saturated—



(3) All aromatic compounds are formed by saturating these free units with other elements or radicals. (4) The differences observed in certain groups of isomeric aromatic compounds are caused by the different relative position of certain elements or radicals in the nucleus. The speaker then gave an account of the isomerism in this series on Kekulé's well-known hypothesis, and explained *the different effect of oxidising* agents on the benzenes containing one, two, or more hydrogen atoms replaced by alcohol radicals, which he illustrated by the oxidation of the isomerides, ethyl benzene, α cymene, and β cymene. Oppenheim regards oil of turpentine as a hydrogen addition-product of the hydrocarbon, $C_{10}H_{14}$; and other aromatic hydrocarbons exist having less hydrogen than that required by the formula C_nH_{2n-6}. Amongst the products of the destructive distillation of coal, a hydrocarbon, $C_{10}H_8$, *naphthaline*, always occurs, which bears such a close chemical resemblance to benzene that it must have a constitution very similar to it, and which Erlenmeyer considers to be—



This view is substantiated by the action of oxidising agents on the pentachlornaphthaline produced by the action of phosphorus-pentachloride on dichlornaphthylquinone. Anthracene, $C_{14}H_{10}$, frequently occurs, accompanying naphthaline in coal-tar, and its probable constitution has been ascertained by Graebe and Liebermann, in their researches on alizarine, to be—



The author also mentioned pyrene, $C_{16}H_{10}$, chrysene, $C_{18}H_{12}$, and idrialine, $C_{22}H_{14}$, and concluded by observing that no branch of our science better illustrated the progress made in chemistry during the last thirty years than that of the hydrocarbons; and this he considered to be due mainly to the atomic theory, which had been gradually developed and expanded to its present state by the efforts of various eminent chemists, amongst whom he might mention Laurent and Gerhardt, Williamson, Odling, and Kekulé.

The PRESIDENT said that, in the interesting lecture they had just heard, Dr. Schorlemmer had amply demonstrated how important this department of modern chemistry was, and how many problems could be illustrated and explained by studying the compounds of carbon and hydrogen; but he would remark that the line of demarcation drawn by including all carbon compounds, or, what amounts to the same thing, all hydrocarbons and their derivatives under the head of organic chemistry, has its defects, as in teaching he must plead for the advantage derived from retaining such compounds as carbonic acid and carbonic oxide amongst inorganic compounds; this could readily be done by a simple modification of the definition, making it to include all compounds in which the carbon is united directly either with carbon, hydrogen, or nitrogen; this would exclude carbonic acid and carbonic oxide, and include all that was desirable. With regard to the observation which the lecturer had made with reference to the non-existence of a difference between the several bonds of the carbon atoms, he must say that the evidence of such a difference was very slight; still there were a few compounds described which appear to give some foundation for this view—amongst these he might mention the two methylic bromides, and also the question as to whether an isomeric ethylic chloride was not formed along with the normal ethylic chloride by the action of chlorine on ethylic hydride. Dr. Schorlemmer had conclusively shown that the normal chloride was produced in this reaction; but he believed he had not shown that nothing else was produced. Again, in the

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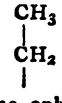
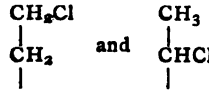
wonderful chain of carbon atoms suggested by Kekulé as the benzene nucleus, it occurred to him that it would be possible to have more than three isomeric dimethylbenzenes; for instance, in the case where the methyls were united to two adjacent carbon atoms in the ring which were themselves united by one bond, must be different from a similar compound where the carbon atoms were united by two bonds: no doubt the difference would be minute, and therefore very likely to be overlooked.

Dr. WRIGHT said there were one or two points he would like to ask about, one of which was, that as Dr. Schorlemmer had shown that when a normal paraffin—



is acted upon by chlorine only two monochlorides are formed, viz.,—



none of the links except the two terminal ones being attacked, could he give any theoretical explanation of this? With respect to the olefines, and the formation of C_2H_4 by the action of metals on C_2H_5I, he might say that, in an experiment he had made with a mixture of $C_2H_4Br_2$ and $2(C_2H_5I)$, C_2H_6 and C_2H_4 were evolved, the latter being proved to be the normal olefine, by its yielding normal ethylene bromide when passed into bromine. As the names ethylene and ethylidene are given to the two hydrocarbons, the first of which is known in the free state, and the latter only in combination, he would suggest the term olefidene as a generic term corresponding with olefine for the latter series. With respect to the hydrocarbons, $C_{10}H_{16}$, yielding terephthalic acid by oxidation, although myristicene from nutmegs yields about 15 per cent of that acid, he had met with at least one instance, viz., the essential oil from orange peel, from which he could not obtain any trace of terephthalic or isoterephthalic acids.

Dr. MULLER said that from oil of turpentine the yield was very small, 10 or 12 lbs. giving only 2 or 3 ounces of acid; in fact, from his experiments, he was inclined to believe, although he had no absolute proof of it, that the terephthalic acid was derived from traces of cymene present in the essential oils.

Dr. ARMSTRONG remarked, with regard to the constitutional formula for anthracene given by Graebe, and the splitting up of anthraquinone, under the influence of oxidising agents, into benzoic acid, this could be equally well explained from the fundamental property of the C_6H_5 group of resisting oxidation; in the case of benzene itself, one portion was oxidised to formic acid, carbonic acid, and water, and another formed benzoic acid.

Dr. SCHORLEMMER replied that, with respect to the action of chlorine on ethylic hydride, the products were ethylic chloride and chlorinated ethylic chloride, but a considerable portion of the gas was unacted upon and carries off with it much of the ethylic chloride. As to chlorine attacking only the two end links in the carbon chain of the paraffins, thus forming only two monochlorides, he had no theoretical explanation to offer: he simply knew it as a fact.

The PRESIDENT said he had been about to ask the Fellows for a vote of thanks by acclamation to Dr. Schorlemmer for his interesting lecture, but they had rendered that unnecessary. He would now ask the Secretary to read the list of communications for the next meeting.

The meeting then adjourned until Thursday, April 18th, when the following papers will be read:—"On the Action of Phosphorus Pentasulphide on Tetrachloride of Carbon," "On the Degree of Solubility of Silver Chloride in Strong Nitric Acid," and "On a Remarkable Salt Deposited from the Mother-Liquors obtained in the Manufacture of Soda," by T. E. Thorpe; "On a Double Sulphide of Gold and Silver," and "On the Solvent Action of Various Saline Solutions upon Lead," by M. M. P. Muir; "On the Composition of Ceylon Jargons," by M. H. Cochrane; "On the Magnetic Sand of Mount Etna," by J. B. Hannay; and "On a Compound of Sodium and Glycerine," by E. A. Letts.

CORRESPONDENCE.

JAMES BARWICK JACKSON.

To the Editor of the Chemical News.

SIR,—Many of your readers will learn with deep regret the sudden disappearance from among us of a well-known and useful man, whose familar face and obliging manners will be long remembered by them. I allude to James Barwick Jackson, of the firm of Messrs. Jackson and Townson, manufacturers of chemical apparatus and reagents, who has been cut off from his laborious career by a short but severe attack of inflammation of the lungs and at a comparatively early age. Many of your readers will, like myself, feel his loss keenly, and join with me in paying a slight tribute to his memory by desiring to record his name and the sympathy felt for his family and his partner, in the columns of your widely circulating journal.

Jackson's life has been one of much value to many of us, and especially so to English analytical chemists, by the skill and care with which he has supplied us for so many years with new and elaborate apparatus, with chemical novelties of every description, and with the numerous chemical products constantly required in the laboratory. When we add to this his extensive practical knowledge, his polite attention, his constant anxiety to please, and, above all, his most excellent and upright character, it will not be difficult, even for those who did not know him personally, to appreciate his services, and to realise the loss we have experienced by his death. Fortunately, he has left behind a worthy son, capable of continuing in his father's steps, and whose love of chemistry has been increased by careful study at one of our Universities.—I am, &c.,

T. L. PHIPSON, Ph.D., F.C.S.,
Member of the Chemical Society of Paris.

London, April 6, 1872.

MISCELLANEOUS.

Adulteration of Whisky.—At the last meeting of the Chemico-Agricultural Society at Belfast, under the presidency of Dr. Knox, late Poor Law Inspector, the subject of whisky adulteration was brought under consideration by Dr. Hodges, who exhibited a specimen of that liquid brought to him by two men who had been physically incapacitated by drinking a small portion of it in a public-house. He found, on analysis, that it contained a large amount of naphtha. He had also discovered that ingredients of even a more deleterious character were used in the process of adulteration,—mixtures containing sulphate of copper (blue stone), cayenne pepper, sulphuric acid (vitriol), and a little spirits of wine. One specimen submitted to Dr. Hodges by a number of provision cutters and curers, was composed of naphtha and a slight colouring of whisky. The men who had imbibed a small quantity of it were affected with serious symptoms; and this, said Dr. Hodges, was a fair specimen of the drink sold in low-class public-houses. The trade in this noxious compound is carried on with impunity, no local authority in Belfast or in the Province of Ulster caring to

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exercise the powers with which the legislature has invested them for the suppression of the traffic.

A Measure for the Intensity of Light.—Dr. Vogel proposes *nitroprussidiron* as a suitable salt for determining quantitatively the intensity of light. For the preparation of this reagent, dissolve chemically pure oxide of iron, best obtained from the oxalate, in hydrochloric acid, and evaporate nearly to dryness to expel the excess of acid; and after filtering, add an aqueous solution of nitroprussidnatrium in proportion of three of the iron to two of the latter. There is usually a slight precipitate produced by this mixture, which can be collected on a filter; but this operation must be performed in a dark room. We have now a liquid excessively sensitive to the action of sunlight. By exposing a small quantity of a known specific gravity to the action of light, a precipitate of prussian-blue will instantly begin to fall; and, on redetermining the sp. gr. in the dark chamber, its decrease will be found to be proportional to the precipitate; and we have thus the data for measuring the intensity of light. It was found by Dr. Vogel that the liquid, exposed for forty-eight hours before a kerosene lamp, was not in the least affected, but a piece of magnesium wire, when burned, immediately produced a precipitate. By employing a long instrument graduated in millimetres, it would appear to be possible to measure the intensity of the light by the number of millimetres occupied by the precipitate. The invention has an important bearing upon photography.—*Scientific American.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, March 11, 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Proportion of Ozone Contained in Country Air, and on the Origin of that Ozone.—A. Houzeau.—In this essay the author discusses the means of at least approximatively estimating the proportion of ozone met with in country air at a height of 2 metres above the surface of the soil. Taking the specific gravity of ozone, according to Soret, at 1·658, the author deduces from his experiments that the country air (but where is not stated) contains a maximum of 1-450,000th of its weight, or 1-700,000th of its bulk, of ozone. As regards the origin of ozone, the author holds it to be due to atmospheric electricity constantly acting in the manner of a huge-sized condenser between the soil and the clouds.

Density of Hydrochloric Acid.—M. Kolb.—The contents of this essay, elucidated by a series of tabulated forms exhibiting the percentage composition and specific gravity, at 0° and 15°, of hydrochloric acid of from 0 to 25·2 areometrical degrees, and also observations on the tables of Davy and Dr. Ure bearing on the percentage composition and specific gravity and areometrical degrees corresponding therewith, are not, for the obvious reasons here alluded to, suited to any further detailed quotation, notwithstanding their high scientific as well as practical value.

This number also contains a very large number of valuable papers relating to meteorology, astronomy, natural philosophy, and zoology.

March 18, 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral subjects:—

Phenomenon of Crystallisation of a very Concentrated Saline Solution.—Professor Chevreul.—The author describes at great length some phenomena observed by him while inspecting certain saline solutions left standing for spontaneous evaporation for some thirty years, but, notwithstanding the scientific value of these observations, we cannot enter here into any details on this subject, owing to the great *length of this memoir.*

Formation of Chloral.—A. Wurtz and G. Vogt.—In the introduction to this very lengthy essay, the authors discuss the mode of action of chlorine upon aldehyde, whereby chloride of acetyl—

$$CH_3-COCl,$$

is formed. When, however, the aldehyde is mixed with alcohol, and then submitted to the action of chlorine and some iodine, there is formed a tetrachlorated ether, which is readily converted into chloral. When pure, this ether is a colourless liquid, boiling at between 185° and 188°; sp. gr. at 0° = 1·426; it is identical with the compound $C_4H_6Cl_4O$, described by Malaguti as resulting from the direct action of chlorine upon ether, and is also identical with the body recently obtained by Dr. Henry while causing perchloride of phosphorus to act upon the alcoholate of chloral. The ether alluded to, being heated in a sealed tube along with water to 100°, is dissociated, forming alcohol, hydrochloric acid, and chloral, according to the following formula:—

$$\underbrace{CCl_3-CH\left\{\begin{matrix}OC_2H_5\\Cl\end{matrix}\right\}}_{\text{Tetrachlorated ether.}}+H_2O=HCl+C_2H_5.OH+\underbrace{CCl_3-COH.}_{\text{Chloral.}}$$

When the ether just named is heated along with alcohol at 100° for some days, the result is that it is converted into hydrochloric acid and trichlorated acetal—

$$\underbrace{CCl_3-CH\left\{\begin{matrix}OC_2H_5\\Cl\end{matrix}\right\}}_{\text{Tetrachlorated ether.}}+C_2H_5.OH=ClH+\underbrace{CCl_3-CH\left\{\begin{matrix}OC_2H_5\\OC_2H_5\end{matrix}\right.}_{\text{Trichlorated acetal.}}$$

Again, by distilling the tetrachlorated ether with sulphuric acid, there is formed chloral, in addition to chloride of ethyl. A very large portion of this exhaustive essay is entirely devoted to the detailed description of a series of experiments mainly made with the view to prove that, by a circuitous process, chloral may be obtained as a derivative of aldehyde.

Researches on the Preservation of Wines.—M. de Vergnette-Lamotte.—The contents of this memoir and of that following are only valuable to wine-growing countries:—

Observations on the Preservation of Wines.—M. Pasteur.

Absorption-Spectra of the Vapours of Sulphur, Selenious Acid, and Hypochlorous Acid.—D. Gernez.

Isomers of Trichlorhydrine—Reproduction of Glycerine.—C. Friedel and R. D. Silva.—After first briefly alluding to some of their former researches on this subject, and reminding the reader that, by the action of chlorine upon the chloride of isopropyl, there are formed two isomeric bodies, a chloride of propylen and methyl-chlor-acetol, the authors in this essay describe at great length the results of their researches made more especially for the purpose of reproducing glycerine from a body not originally obtained from that substance. The authors have now succeeded with the chloride of propylen, which is first converted into trichlorhydrine, and the latter into real glycerine, which, again, has been converted into iodide of isopropyl.

Conversion of Acetone into Hydride of Hexylen (Dipropyl).—G. Bouchardat.—The main object of the results of researches published in this memoir is to prove that pinacone (a body formed from acetone by the action of nascent hydrogen upon that substance) may be converted, under powerfully hydrogenising influences, into a carburetted hydrogen containing double the equivalents of carbon of those contained in acetone. The author describes at great length his modes of experimenting. The body resulting from the reactions is hydride of dipropylen, $C_{12}H_{14}$, and is isomeric with a compound obtained by hydrogenising benzine.

Facts Relating to Diphenylamine.—Ch. Girard and G. de Laire.—The contents of this paper are the same as have been mentioned in our issue of March 1 (vol. xxv., p. 107) as contained in *La Revue Scientifique de la France et de l'Etranger.*

Some Observations on Colourless Bile.—E. Ritter.—The author quotes in this memoir the results of a series of analyses made by him on colourless bile, taken from the gall-bladders of men and animals submitted to autopsy. As an instance of the composition of such bile (as yet hardly ever analysed, since the colourless fluid has been taken to be mucus) we mention here the following, in 1000 parts:—Water, 923·5; salts, 12·4; fat and cholesterine, 6·8; organic matter, 21; salts of the bile acids, 55·2. It appears that colourless bile and fatty degeneration of the liver are somehow connected together.

Discovery of a Shoal of Fossil Fish in the Coarse Limestone (Calcaire Grossier) Deposits of Puteaux, near Paris.—Dr. S. Meunier.—The author relates at great length a palæontological discovery of a shoal of fossil fish, *Hemirynchus Deshayesi*, in a limestone quarry near Puteaux.

This number also contains very important papers on meteorology, natural history, and physics.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 5, 1872.

This number contains the following original papers and memoirs:—

Studies on the Combinations of the Camphor Group.—J. Kachler.—The author treats first on campholic acid, originally discovered by Malin and described by him in *Ann. d. Chem. u. Pharm.*, vol. cxlv., p. 201; it is prepared from camphor by the action of potassium upon it, when dissolved in a petroleum of high boiling-point (130°); the formula of this acid is $C_{10}H_{18}O_2$. When treated bromine and water, no substitution-product is formed the final

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of the reaction being the formation of oxycamphoric-acid-anhydride. With phosphor-chloride, campholic acid forms the compound—

$$C_{10}H_{17}OCl,$$

an oily fluid, decomposed by water. Referring to the results of Delalande's experiments (*Journ. f. Prakt. Chem.*, vol. xxiii., p. 392) on the product of the dry distillation of campholate of lime, an oily liquid, termed by the last-named author campholon, $C_{19}H_{34}O$, the author states that on taking the vapour density (not determined by Delalande) he found it did not agree with that formula, and that camholon is nothing else than impure campholen, C_9H_{16}, also described by Delalande, the author having also prepared pure campholen; campholic acid is rather soluble in water. Camphin acid is next treated of, this body having been prepared, according to Berthelot's method, by the action of caustic potassa upon camphor in alcoholic solution; the acid alluded to is obtained as a sour fluid of syrupy consistency, but, on further investigation, this substance is found to be nothing more than campholic acid mixed with a brittle, resin-like, faintly acid body, which, on being treated with caustic alkali, yields camphor, leaving a terpen-like resin.

Dextronic Acid.—J. Habermann.—The acid alluded to is formed from dextrin in the same way as lactonic acid is formed from sugar of milk (see Hlasiwetz and Barth, *Ann. d. Chem. u. Pharm.*, vol. cxxii., p. 96), by first treating a solution of dextrin with bromine, and next with oxide of silver; the dilute acid solution is then neutralised with pure carbonate of lime, yielding dextronate of lime, which crystallises, forming aggregates of bright white-coloured very small needle-shaped crystals. This salt is isomeric with the lime salt of gluconic acid, $C_6H_{11}CaO_7+H_2O$. Dextronate of lime is not identical with the salt just named, because it is found to differ in its optical polarisation property.

New Acid from Aloes.—P. Weselsky.—The author found, while preparing orcin from aloes by the action of fusing caustic potassa, a new acid, which is very nearly related to evernic acid in its constitutional formula, that of the new acid being—

$$C_6H_2\begin{cases}OH\\CH_3\\CH_3\\COOH\end{cases}$$

and that of evernic acid—

$$C_6H_2\begin{cases}OH\\O.CH_3\\CH_3\\COOH\end{cases}$$

The new acid is very like gallic acid; it is difficultly soluble in cold water, readily in boiling water, and very readily in boiling alcohol and ether; treated with fusing caustic potassa, the new acid is dissociated, yielding orcin and acetic acid, according to the formula—

$$\underbrace{C_9H_{10}O_5}_{\text{New acid.}}+H_2O=C_7H_8O_3+C_2H_4O_2.$$

The author proposes to name this acid alorcinic acid.

Phenomenon of Affinity According to the Multiples of Common Constant Numbers.—J. Thomsen.—Notwithstanding the very high scientific value of this essay, we can only quote here the headings of the sections into which it is divided—Formation of the oxides of sulphur from their constituents; formation of the oxides of nitrogen; formation of the oxides of manganese; formation of sulphates from their constituents; retrospective review and concluding observations.

Worthlessness of the Values of the Figures Quoted by Dr. Berthelot and Published by him in his Essay "Sur la Chaleur de Formation des Azotates, sur la Chaleur de Formation des Composés Oxygénés de l'Azote," &c.—J. Thomsen.

Action of Fusing Caustic Potassa upon Braunkohlen.—L. Schinnerer and T. Morawski.—The authors first call to mind the facts that fusing caustic alkalies convert wood (cellulose) into oxalic acid, and charcoal into humus substances, and then state that they were induced to try the effect of fusing caustic alkalies upon braunkohlen from Traunthal (braunkohle is not, we believe, met with in the United Kingdom, and is a less completely converted [in a peculiar sense] mineral than the coal of the genuine coal formation). The result of the action of fusing caustic soda upon this fossil mineral is the formation of a substance of very nearly the composition of pyrocatechin, viz., a body containing in 100 parts—C, 65·45; H, 5·45. The authors further found that the portion of this fossil fuel soluble in ether is that which yields this substance. A series of similar kinds of coal were treated in the same way and gave the same result, but genuine coal of the true coal formation is not at all acted upon by fusing caustic alkalies.

Researches on Derivatives from Glycerine.—L. Henry.—This essay, although styled a preliminary communication, is, notwithstanding its great intrinsic merits, not suited for useful abstraction, mainly owing to the fact that it contains very complex and lengthy formulæ.

Derivatives of Uramido-Benzoic Acid.—P. Griess.—The second instalment of a monograph on this subject, this portion being divided into the following sections:—Introduction; decomposition of isomeric dinitro-uramido-benzoic acid by liquid ammonia at boiling heat; α-nitro-uramido-benzoic acid, $C_6H_7(NO_2)N_2O_3$; β-nitro-uramido-benzoic acid, same formula as foregoing; γ-nitro-uramido-benzoic acid, also same formula; action of tin and hydrochloric acid upon the isomeric nitro-uramido-benzoic acids; action of concentrated nitric acid upon the isomeric nitro-amido-benzoic acids; α-, β-, and γ-dinitro-uramido-benzoic acids, $C_6H_6(NO_2)_2N_2O_3$; decomposition of isomeric dinitro-benzoic acids by boiling their aqueous solutions; action of tin and hydrochloric acid upon the isomeric nitro-amido-benzoic acids; action of nitrous acid upon the isomeric diamido-benzoic acids; decomposition of isomeric diamido-benzoic acid at a higher temperature.

Preliminary Communication.—V. Meyer and O. Stüber.—The authors first state that according to theory there must exist, although they may not be isolated, two isomeric nitrous acids, but there may exist a series of nitrous acid ethers, the constitution of which corresponds to the nitro-derivatives of the aromatic compounds; for instance—

Nitrite of ethyl. Nitro-ethan (unknown).

The authors then relate at some length the results of a series of experiments made with the view to prepare such bodies; for this purpose dry nitrite of silver was caused to act upon iodide of amyl, the result being the formation, among other substances, of a compound—

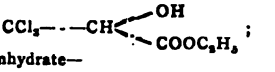
$$C_5H_{11}NO_2,$$

a fluid boiling at between 150° and 160°—that is to say, an isomeric nitrite of amyl. The authors continue these researches.

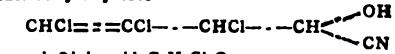
Constitution of Croton-Chloral.—A. Pinner.—Notwithstanding the scientific merits of this memoir, its contents are not suited for any useful abstraction.

Trichlor-Lactic Acid and Trichlor-Angelactinic Acid.—C. Bischoff and A. Pinner.—The first portion of a monograph on this subject, divided into the following sections:—Introduction; trichlor-lactic acid, $C_3H_3Cl_3O_3$, or—

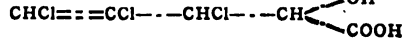
ammonium, potassium, sodium, and zinc salts of this acid; ethyl-ether—



croton-chloral-cyanhydrate—



trichlor-angelactinic acid, $C_5H_3Cl_3O_3$, or—



Les Mondes, March 21, 1872.

Agricultural Instruction (Enseignement Supérieur d'Agriculture).—J. Dumas.—At the suggestion of the eminent *savant* just named, the Minister of Public Instruction has decreed the formation of a school of superior agricultural instruction, in connection with and at the well-known celebrated Ecole Centrale des Arts et des Manufactures at Paris, to which is also to be added a professorship of theoretical and practical artillery science.

Report on the Researches and Experiments Made by the Spectroscopic Association of Italy.—H. Tarry.—This paper bears excellent testimony to the fact that united Italy is rapidly advancing in science, to which men of all parties and creeds largely contribute, and not the least so the eminent Societatis Jesu Socii.

Memoir on the Employment of Secondary Currents for the Purpose of Accumulating or Transforming the Effects of the Galvanic Battery.—M. Gaston-Planté.—The continuation and end of this essay.

Newly-Devised Experiment for Demonstrating the Mechanical Cause of the Ebullition of Water.—F. Marco.—The lengthy description of an experiment made for the purpose of demonstrating that air is the mechanical cause of the phenomenon of ebullition of water, and that, as soon as the air is completely removed from that liquid and access of air prevented, the ebullition of water does not take place at all, even if it be heated to 148°.

Ventilating Caloriferes.—Dr. J. Casse.—This paper, illustrated by several woodcuts, contains the detailed description of an apparatus (a kind of stove) the use of which gives the following results:—Continuous supply of fresh air at a conveniently high temperature; great saving of fuel; simplicity of construction; while, lastly (what is of importance in schools, churches, courts of law, &c.), the sonorous waves of the air of the room where this apparatus is used are gently but completely forced downwards from the ceiling, so that less effort and less strength of voice is required on the parts of the speakers.

Le Moniteur Scientifique Quesneville, No. 363, March, 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Study on the Quantitative Estimation of Phosphoric Acid in all Products of Agricultural Interest and those belonging to the domain of Physiology.—Dr. Joulie.—The first instalment of a very lengthy and complete essay on this subject, which is treated so as to be useful to practical chemists as well as agriculturists; but the great length of this memoir prevents us, notwithstanding its intrinsic value, from entering here into any further details.

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Anthracen and its Derivatives.—Dr. E. Kopp.—The continuation of this exhaustive monograph. This portion contains the following sections:—Action of oxychloride of carbon upon anthracen; action of sulphuric acid upon anthracen and its derivatives; sulphanthracenic acid; sulphanthraquinonic acid and its salts; bisulphanthraquinonic acid; sulphoxy-anthraquinonic or sulphalizarous acid.

Disulpho-Anthracenic Acid.—C. Mayer.—The acid here named—

$$C_{14}H_{10}2SO_3 = C_{14}H_8 \begin{cases} SO_3H \\ SO_3H \end{cases}$$

was prepared by the author from previously purified commercial anthracen, which was next treated with sulphuric acid, 4 parts to 1 of anthracen; but the crude disulpho-anthracenic acid thus obtained as a brown-black coloured mass is very difficultly rendered pure, and can only be so made by a rather circuitous process of first making a lead salt of it, and converting this into a baryta salt, and that again into a soda salt, which crystallises in small acicular shape, is yellow-coloured, and readily soluble in water. The pure disulpho-anthracenic acid obtained from the pure baryta salt is a red-coloured crystalline body, very soluble in water and yielding a brilliantly red-coloured solution.

Industrial Preparation of Anthracen.—M. Audouin.—In this paper the author, Directeur Gérant of the Paris Gaslight Company, describes at length a process by which, on the large scale, the greater part of the anthracen contained in coal-tar may be obtained and purified at gas-works. The main features of the process are the combination of distillation and refrigeration (Carré's apparatus), followed by a series of refining operations. The process has been patented in France and other countries.

Preparation of a Pulverulent Manure from Human Fœcal Matter.—F. Jean.—The author describes a process which mainly consists in adding to the *bourbasse* (that is to say, the contents of a tank, or water-tight cistern, which communicates with the *lieux d'aisances*, and wherein no water is poured except urine, forming, with the fæces, a liquid of which a litre weighs about 1050 grms.; *bourbasse*, in Belgium known as *beer*, a Flemish word largely used for liquid manuring) upon 100 parts, 10 parts of strong sulphuric acid, and next 13 parts of coprolites at 45 per cent of tribasic phosphate. After the mass has been well stirred, there is added, to 50 parts of sawdust, and next 27 parts of sifted coal, wood- or peat-ash, when, after some few days, according to the state of the weather, the mixture is dry and pulverulent, and found to consist, on analysis, in 100 parts, of—Water driven off at 100°, 14·8; organic matter and water driven off at 200°, 53·6; mineral matter, 31·6. This manure contains 1·554 per cent of nitrogen and 1·867 of soluble phosphates.

Washing Mixture.—Dr. Quesneville.—The very common use, especially in England, of soda for washing linen is very injurious to the tissues, and, moreover, has the effect of yellowing it in the long run. The author states that in Germany and Belgium the following mixture is now extensively and beneficially used:—2 lbs. of soap are dissolved in 25 litres (5·5 gallons) of water as hot as the hand can bear it; there are next added to this fluid three large-sized tablespoonfuls of liquid ammonia and one spoonful of best oil of turpentine. These fluids are incorporated rapidly by means of beating the soap-suds and other fluids with a small birch-broom. The linen, &c., is then put into this liquid and soaked for three hours, care being taken to cover the washing-tub with a closely-fitting wooden lid; by this means the linen is readily cleansed, requires hardly any rubbing, and less brushing, and there is a saving also of time and fuel. Ammonia does not affect the linen nor woollen goods, and is largely used as washing-liquor in the North of England, of course along with much water as above indicated.

MEETINGS FOR THE WEEK.

MONDAY, April 15th.—Medical, 8.
—— London Institution, 4. Mr. E. J. Hopkins, "On Music."
TUESDAY, 16th.—Civil Engineers, 8.
—— Zoological, 9.
—— Royal Institution, 3. Dr. W. A. Guy, F.R.S., "On Statistics, Social Science, and Political Economy."
WEDNESDAY, 17th.—Society of Arts, 8.
—— London Institution, 7. Prof. Barff, on "Colour."
THURSDAY, 18th.—Chemical, 8. Mr. E. A. Letts, on "A Compound of Sodium and Glycerine," and "On Benzyl-Isocyanate and Isocyanurate." "Notes from the Laboratory of the Andersonian Universaity."
—— Royal, 8.30.
—— Royal Society Club, 6.
Royal Institution, 3. Dr. Tyndall, LL.D., F.R.S., "On Heat and Light."
—— Zoological, 4.
FRIDAY, 19th.—Royal Institution, 9. A. Vernon Harcourt, Esq., F.R.S., "On the Sulphurous Impurity in Coal-Gas and the Means of Removing it."
SATURDAY, 20th.—Royal Institution, 3. R. A. Proctor, Esq., B.A., "On Star-Depths."

NOTES AND QUERIES.

Tungsten Compounds.—Would any of your correspondents kindly inform me of the name of the makers of tungstic acid, or the products of tungsten (such as tungstate of soda, barytes, &c.)?—NEMO.

Atmospheric Air.—(Reply to "Subscriber.")—Asbestos is not well suited for the purpose you name, on account of not possessing the suppleness and elasticity of fibre, and thus not permitting the formation of very small interstices for the air to be sifted through; but you can easily try a comparative experiment, and thus settle this point fully; perhaps you can get the very long-fibred Bohemian asbestos, which is like raw silk, and is used for being woven into asbestos cloth.

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The Session 1871—1872 will commence on the 2nd of October, when the Laboratories will re-open at 10 a.m. for Instruction in Practical Chemistry as applied to Pharmacy, Medicine, Analysis, &c. Pupils can enter at any period. Terms moderate.

THE CHEMICAL and TOXICOLOGICAL CLASS will meet as usual every Monday and Thursday evening, commencing October 2nd, at 8 p.m.

The LATIN CLASS for the reading of Physicians' Prescriptions, Cæsar's Commentaries, &c., every Tuesday and Friday evening, commencing October 3rd, at 8 p.m.

The BOTANICAL and MATERIA MEDICA CLASS, every Wednesday and Saturday evening, commencing October 4th, at 8 p.m. The usual EXCURSIONS for the STUDY of PRACTICAL BOTANY will be continued every Saturday, until further notice, at 10 a.m.

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THE CHEMICAL NEWS.

Vol. XXV. No. 647.

SECOND REPORT OF THE ROYAL COMMISSION ON SCIENTIFIC INSTRUCTION AND THE ADVANCEMENT OF SCIENCE.*

To the Queen's Most Excellent Majesty.

May it please Your Majesty,—We, the Commissioners appointed by Your Majesty to make inquiry with regard to Scientific Instruction and the Advancement of Science, humbly beg leave to present to Your Majesty the following Report on Scientific Instruction in Training Colleges and Elementary Day Schools under the Education Department, and in Science Classes under the Science and Art Department.

I. Scientific Instruction in Training Colleges and Elementary Day Schools.

State of Instruction prior to the Introduction of the Revised Code.

In dealing with the scientific instruction in training colleges and elementary day schools, your Commissioners have, in the first place, inquired what provision was made for such instruction before the introduction of the Revised Code in 1861.

In order to show more distinctly the state of scientific instruction in training colleges and elementary schools before 1861, extracts are given from the evidence of the Rev. Dr. Rigg, Principal of the Wesleyan Training College, Westminster, and of the Rev. Cannon Cromwell, Principal of St. Mark's College, Chelsea.

Influence of the Revised Code upon Scientific Instruction.

We now proceed to consider the influence of the Revised Code of 1861, which introduced the system of individual examination, proposed in the Minute of 1853. While we approve the principal that the grants to schools should be determined to a considerable extent by the results of individual examination, we are of opinion that the limitation of such examination to the subjects of reading, writing, and arithmetic unfortunately narrowed the instruction given in elementary schools; and that this change, together with the lower standard adopted in the training and examination of pupil teachers, and the curtailment of the syllabus of the training colleges, exercised a prejudicial effect on the education of the country.

The general apprehension inspired by these changes rendered the profession of schoolmaster less popular. The education of the pupil teachers was generally impaired, fewer candidates were apprenticed, and the number of those who resorted to the training colleges fell off.

It is right, however, to point out that the consequences to which we have referred have been in part obviated by the operation of the system introduced by the Science and Art Department. So strong was the conviction of the principals of certain of the training colleges, that elementary scientific knowledge was of great value to their students, that, in the absence of any assistance from the Education Department, they prepared their students for the May Examinations of the Science and Art Department, and permitted them to attend those examinations, thus qualifying themselves to earn grants under that department.

Among the impediments to higher instruction in training colleges, besides the restricted range of the syllabus of studies, the absence of sufficient indication of the objects and limits of the examination papers is also the subject of important evidence from Dr. Rigg and Canon Cromwell. Dr. Rigg represents that the principals or committees of training colleges have slender opportunities of making any "deliberate representations upon the subject to the Committee of Council." We are of opinion that occasional conferences on the syllabus might be useful, in giving the department the aid of the practical experience of principals, of inspectors, and of men of science.

The New Code of 1871.

The New Code of 1871 does not affect the training colleges except so far as relates to religious inspection, and, from the evidence we have taken, we fear it will practically have little effect in widening the range of the education in elementary schools; that, as heretofore, the grants will, in future, be almost wholly given for reading, writing, and arithmetic; and that little encouragement will be afforded to the study of other subjects, even of history and geography.

It is obvious that if 75 per cent of the children pass in reading, writing, and arithmetic, the school will earn the maximum grant, and, in fairly good schools, this amount of success has been, and we doubt not will be, attained without difficulty. Nor do we think it would be desirable that the standards should be raised in such a manner as to reduce the passes below this proportion; such a course would, we think, tend to discourage both the masters and pupils. The last Report of the Education Department shows that the existing schools did, in fact, earn last year almost the full grant, without any assistance from the extra subjects, and those schools which are unable to pass the children in the elementary subjects are certainly not likely to be successful in others of a more advanced character.

We do not wish to underrate, in any way, the necessity of careful instruction in reading, writing, and arithmetic, as the very foundation of education; but we do not believe that the introduction of extra subjects would in any way interfere with it.

Although we are not at present prepared to recommend any change in the existing system under which the number of extra subjects is limited and the choice left to the school managers, we trust that the time may not be far distant when it may be possible to introduce a more systematic programme of instruction in elementary science.

Meanwhile, we submit that the scale of payments in boys' and girls' schools might be so arranged as to encourage the regularity of the attendance of the scholars; to promote the employment of a sufficient staff of teachers; and to ensure the success of the teaching of the three elementary subjects, while a sufficient reward was given for proficiency in the extra subjects. Even without altering the maximum of 15s., we conceive that scales of payment might be adopted by which it would be possible to afford adequate encouragement to humble rural schools; to increase the general intelligence of the scholars in all schools, and thus to make success in the teaching of the rudiments more certain, while the range of instruction was enlarged, and the standard raised.

General Observations.

From a consideration of the evidence we are of opinion that instruction in the elements of natural science can be, and eventually ought to be, made an essential part of the course of instruction in every elementary school.

The instruction to which we refer, though scientific in substance, should, in form, be devoid of needless technicality, and should be almost wholly confined to such facts as can be brought under the direct observation of the scholar. It should, in fact, be conveyed by object lessons, so arranged and methodised as to give an intelligent idea of those more prominent phenomena which lie around every child, and which he is apt to pass by without notice.

A course of object lessons of the nature here indicated

* Abridged.

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could be given even to the junior classes of elementary schools, not only without in any way interfering with the efficiency of other instruction, but with the effect of aiding the general development of the intelligence of the children; and similar advantages would attend teaching of a like kind, but of a somewhat more advanced character, in the senior classes.

The scientific instruction thus afforded would, within the narrow limits to which it extends, give a sound acquaintance with the elements of physical science. It would, therefore, possess very considerable intrinsic value, especially in localities in which classes under the Science Department have not been established; while in those places in which science classes are accessible, it would render the additional service of preparing the scholars for them, and thus enable the teachers to raise the standard of their instruction.

It is of great importance to remember that in order to render the scientific instruction in elementary schools as successful as possible, the teachers must not only have acquired the needful amount of scientific knowledge, but must also have been carefully trained in the special methods of teaching science.

A reasonable hope may be entertained that, as the methods of instruction are improved, and the skill of the principal and assistant teachers increases, the standard reached by very young children in infant schools may be much raised without any undue pressure. Moreover, if some of the principal objects for which the Education Act of 1870 was passed be attained, the greater regularity of the attendance of children at school; the economy of time attained by better teaching, and a larger staff of teachers; and the prolongation of the school age; will afford greater facilities for the introduction of elementary scientific instruction in the sense already explained.

In any case, there can be no good reason why such elementary scientific instruction as has long been given in the Primary Schools of Germany and Switzerland should not be bestowed upon English children.

The London and Liverpool School Boards have recently determined to make elementary physical science and social economy essential subjects in all the schools which they provide, and their example will not improbably be followed by other school boards.

While we are clearly of opinion that scientific instruction should form a substantial part of the curriculum of training colleges, we feel the great difficulty which arises from the present condition of the general instruction in those colleges, as disclosed by the Reports of the Inspectors for the years 1870-71.

We fear that an extension of the curriculum, so as to include elementary science, could not be expected to succeed until the means of scientific instruction for the students are more complete, and until the students enter in a better state of preparation, or remain a longer period.

On the other hand, the extension of the time of education in training colleges would obviously raise questions of expense both with respect to the buildings and annual outlay. These questions may bring under consideration the expediency of adopting, to a greater or less extent, the alternative of instruction without board.

Before we leave this part of the subject, we think it expedient to state that the encouragement of instruction in the rudiments of natural knowledge in elementary schools falls properly within the province of the Education Department, and should be adequately provided for in the regulations of the Code issued under its authority.

Recommendations.

I. We recommend, as regards the elder children in the elementary schools, that the teaching of such rudiments of physical science as we have previously indicated should receive more substantial encouragement than is given in the regulations of the New Code.

II. We recommend, as regards the younger children, that Her Majesty's Inspectors should be directed to satisfy themselves that such elementary lessons are given as would prepare these children for the more advanced instruction which will follow.

III. We recommend that the mode of instruction of pupil teachers; the conditions of admission to training colleges; the duration of the course of study in them; and the syllabus of subjects taught, should be so modified as to provide for the instruction of students in the elements of physical science.

II. Scientific Instruction in Science Classes under the Science and Art Department.

This system has given a remarkable impulse to elementary scientific teaching throughout the United Kingdom, some indication of which will be gathered from the following table, showing the number of schools and persons under instruction in successive years:—

	Number of Schools.	Number under Instruction.
1860	9	500
1862	70	2,543
1864	91	4,656
1866	153	6,835
1867	212	10,230
1868	300	15,010
1869	523	24,865
1870	799	34,283

Teachers.

We feel that the experience and skill of even an uncertificated teacher, and the previous literary training of certificated teachers, qualify them to acquire an elementary knowledge in the existing elementary science classes with a greater degree of success than inexperienced students. When they take charge of science classes, the skill they have acquired in giving instruction cannot fail to increase their success as teachers, especially in promoting the development of the intelligence of the pupils.

There are, according to a recent return, 311 private teachers, who are not day school teachers, of whom 259 are persons having other employments in the daytime. These occupations are commonly those of tradesmen's clerks, surveyors' assistants, draughtsmen, mechanics, or handicraftsmen, or persons employed in such trades as dyeing or calico printing. In these last, the work affords some opportunities for acquiring skill in chemical manipulation. It is probable that, notwithstanding the want of training in the management of classes, and in teaching, and the occasional want of literary qualifications, many of these teachers have rendered valuable service. We are also informed that 79 hold honorary science certificates; that 33 of them obtained certificates according to the method of examination in use previously to 1867; and 176 have qualified according to the system now in use by passing in the advanced classes at the May examinations, while 23 hold the certificates awarded in consequence of the examination previously to 1867 in some subjects, and have qualified in other subjects at the present May examinations by passing in the advanced classes. We have no information as to what is the relative scientific knowledge of the several classes of teachers.

The steadily increasing stringency of the examination, ensured both by the character of the questions and the requirements of the examiners as to the answers, has doubtless had considerable influence on the qualifications of the teachers. The operation of the system has been marked by a progressive improvement in the answers to the examination papers.

While the increased stringency of the examinations to which we have already referred supplies a powerful motive to the teachers to improve themselves, an important opportunity of such improvement is afforded by the system recently introduced by the Department of supplying courses of lectures in the metropolis, with opportuni-

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ties of practical instruction, which science teachers are aided in attending by a grant towards their expenses.

We are of opinion that the arrangements for the instruction of teachers have already been of material benefit, though as yet they have been attended by no great number of teachers; and that they may be continued and extended with every prospect of advantage.

We have had before us certain of the examiners: from them we have derived the impression already recorded, that substantial advantages result from the system of instruction pursued; but from the considerable proportion of failures which occur, as well as from the character of the answers given, the examiners are under the impression that a very large part of the instruction is derived from books, tested and aided by the class examinations of the teachers; and that it is not often illustrated by specimens or experiments, the use of apparatus, or the out-door study of nature. One of the examiners even complains that it is clear that the common expedient of the blackboard and chalk is not used to illustrate instruction in geology. We have it in evidence that not only is scientific apparatus wanting, but that too often the teachers confine their instruction to the same routine of book learning and class questioning with which alone they were made familiar in the rudimentary classes in which they received their own imperfect elementary knowledge.

The examiners conclude that when there is a great preponderance of failures in any school, the teacher has systematically endeavoured to prepare his students by an almost exclusive exercise of the memory. Mr. Iselin confirms this impression by reporting that "this defect is most observable in science classes established in connection with, and for the pupils of, elementary schools, where the students are more immediately under the control of the teacher. In order to produce good results, the *youth*, and often the deficiency in primary education of his pupils, compels the teacher to cultivate their memory rather than their intelligence." Teachers of elementary day schools are, as we have already observed, under strong inducements to found evening science classes, and the transfer of scholars immediately from the day to the evening schools is one chief means of filling those classes.

Inspection.

There are only two permanent inspectors of local schools of science and art, and as their inspection extends to the art as well as to the science classes, it is obvious that their supervision must be inadequate to provide any important check against irregularities, or to greatly influence the methods and means of instruction.

The Engineer officers are employed as local inspectors, their only duty being to see that the regulations of the Department are complied with. They are not charged to report upon the methods of instruction adopted by the teachers, as to the degree in which that instruction is limited to text-books, and to class examinations, founded upon such book instruction, nor as to the comparative skill and knowledge of method, or assistance from apparatus or specimens, by which the success of the teaching may be promoted. But a system of inspection embracing these objects, yet without proceeding to systematic individual or class examination, would be of great value as a supplement to the May examination of the papers of the pupils.

Practical instruction in the science classes would be greatly promoted by more frequent inspection, followed by reports on the methods and apparatus employed, and the number of pupils receiving such practical instruction.

Payments on Results.

Payments are made by the Department on account of each successful student of the industrial classes, at the rate of £1 for every second class, in either the elementary or the advanced stage; of £2 for a first class in either of these stages, or for a second class in honours; and of £4 for a first class in honours. Although we do not think that either the times of attendance or the amount and sources of contributions in elementary schools can be strictly compared with those in science classes, it may be worthy of observation that the elementary schools are required to be open 400 times, and no grant is made for the elementary instruction of any boy or girl who has not attended 250 morning or afternoon meetings of the school, whereas the science classes are only required to be open 25 times in the year. The cost per head of teaching each scholar in an elementary school, calculated on the average attendance, ranges from 21s. to 30s.; but the average rate of grant was reduced by the operation of the Revised Code from 12s. 3d. to 8s. 6d. or 9s. per scholar, and the maximum grant attainable under the New Code cannot exceed 15s., nor can it exceed one-half the sum raised by fees and subscriptions.

The expenses are defrayed by school pence and contributions. We have grave doubts whether equivalent subscriptions could, at an early period, have been raised in support of the most improved forms of teaching in the elementary science classes. Nevertheless, we think it worthy of the consideration of the Department whether means could not be adopted to increase the resources of the elementary science classes by greater payments from the pupils, and by local contributions. This will become necessary in proportion as practical instruction is introduced. Though, in the earliest period, to have required local contributions, bearing some proportion to the grants, might have prevented the establishment of the classes, that danger ought, if the instruction is valued, gradually to cease to exist.

General Remarks.

The efficiency of the instruction given in the science classes has been diminished, on the one hand, by the imperfect organisation of the classes, whether considered separately or in groups, and the absence of practical teaching; and, on the other, by the irregular and unsystematic manner in which scholars have taken up the subjects taught.

As an example of the efficiency of scientific instruction as an instrument in the education of boys belonging to the humbler middle classes, and from twelve to fifteen years of age, the Commissioners describe the Bristol Trade School, which was successfully developed under the guidance of the late Canon Moseley, who, both as a Professor at King's College, London, and subsequently as an Inspector of Training Colleges, had prolonged experience of such instruction.

As an example of the grouping of classes for the purpose of introducing the services of more efficient teachers, a brief sketch is given of the organisation of a group of evening classes formed in East Lancashire.

As a remedy for the irregular and unsystematic manner in which students take up subjects for the study of which they are unprepared, the Science and Art Department on Nov. 24, 1871, issued a Minute suggesting the adoption of definitely arranged courses of instruction, and offering encouragement in the form of extra payments to the schools in which such courses are adopted. This minute will be of especial service to the teachers themselves, who have hitherto been in the habit of qualifying themselves successively in different subjects without sufficient regard to their connection.

The undeveloped state of elementary education, and the defects of the only machinery available for the establishment of these classes, rendered necessary the experiment of employing whatever rooms and teachers were at hand. The degree of success attained in the enterprise of thus boldly opening, in spite of all obstacles, a path for the introduction of a system of elementary scientific instruction, is greatly due to the vigorous and able administration of the Department, and to the efficiency with which the examinations have been conducted.

The ground thus prepared may hereafter be occupied,

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step by step, with elementary science schools in well-constructed buildings, supplied with proper apparatus, and a sufficient staff of trained teachers. These schools may train assistant teachers, may group around them humbler classes, and aid them with apparatus and superintendence or instruction.

The first steps have been taken with such vigour, and the result has been to such an extent successful, that we confidently expect that, with needful guidance and encouragement, a thoroughly efficient system of elementary scientific instruction for the working classes may, ere long, be founded on this basis. Our recommendations show in what way, in our judgment, the existing system should be further developed.

Recommendations.

IV. We recommend that the instruction in elementary science classes under the Science and Art Department, be so arranged as to work in complete harmony with the general system of public elementary education, but, at the same time, we consider it important that the Education Department and the department charged with instruction in science shall continue to be co-ordinate.

V. We recommend that a more efficient inspection of elementary science classes be organised, and that the inspectors should advise the local committees and report on :—

(*a*). The apparatus of instruction.
(*b*). The state of the discipline and methods.
(*c*). The general efficiency of the arrangements.

VI. We recommend that teachers who have already qualified by passing the May examination in either of the advanced classes shall continue to be recognised as qualified to conduct elementary science classes, with the title of *Elementary Science Teacher*, and to earn the grants awarded by the Department of Science and Art on the results of the examination of their scholars; but that this qualification and title shall in future only be attainable by passing in the first of the advanced classes.

VII. We recommend that should such arrangements as are hereinafter set forth for conducting the practical instruction of teachers, and for providing for them practical examination at several centres, be adopted, all elementary science teachers shall, after such practical instruction, be admissible to a further examination, which, in all suitable subjects, shall be practical. We recommend that success in this examination shall entitle a teacher to a certificate of *Second Grade Science Master*.

VIII. We recommend that, as an inducement to teachers to prepare for and pass this further examination, payment for results in the case of a Second Grade Science Master be made at a somewhat higher rate than in that of the elementary science teacher.

IX. We recommend that an examination, both by papers and by practical tests, in any group of allied subjects defined by the department which the candidate may select, shall be open to all those teachers who have passed in the advanced classes, or who have been otherwise admitted as science teachers; and that success in this examination shall entitle the candidate to receive a certificate of *First Grade Science Master* in that group.

X. We recommend that a greater capitation grant be payable in respect of the scholars of a first grade science master teaching in any group of allied subjects with or without assistance, than in respect of the scholars of a second grade science master, provided that the Inspector report that the apparatus is sufficient, and that practical instruction has been given in each suitable subject.

XI. We recommend that, with a view of maintaining uniformity of standard in these examinations, they shall be conducted at the several local centres by the staff of examiners acting under the Science and Art Department.

XII. We recommend that the more systematic training of the teachers of science referred to be provided for—

(*a*). By the adoption of special arrangements for this purpose in the science school which has been referred to in our first Report; and by the recognition by the Department of similar arrangements for the instruction of this class of students in any university or college, and in science schools as hereinafter described.

(*b*). By giving to the students of training colleges the opportunity of remaining a third year, during which scientific instruction may either form a principal part of the curriculum of such colleges or be accessible in some adjacent college or school of science approved as efficient for that purpose.

XIII. We recommend that the Science and Art Department be at liberty to dispense with the preceding examinations and to accord the privilege of first and second grade science masters in consideration of university examinations in science, or of a satisfactory course of study in Colleges in which science is taught, as well as in other cases of obvious scientific qualification.

XIV. We recommend that in schools recognised as science schools, as hereinafter set forth, facilities for the employment of assistant teachers be afforded as an experiment on a limited scale, some addition being made to the emoluments of the teacher in consideration of the instruction afforded; provided the Department be satisfied, on the report of an Inspector, that such assistant teacher has received practical instruction in subjects in which it is prescribed, and that he has been actively engaged in teaching.

To encourage the more advanced scholars to become assistant teachers under first grade masters in such schools, a small stipend, rising in successive years, might be granted on condition that a like sum was raised locally, subject to such conditions as the Department might deem expedient. The proportion of assistant teachers should not exceed one for every fifteen successful scholars in any science school, and no scholar should be recognised as an assistant teacher until he has passed in the first division of the elementary class in the May examination.

XV. We recommend that, with a view of training first grade science teachers, exhibitions of sufficient value and in sufficient numbers be offered to elementary science teachers and to assistant teachers who have served three years and passed in the first division of the advanced class in the May examinations; and that such exhibitions should be tenable in any university, college, or science school recognised in Recommendation XII.

XVI. We recommend that the grants made by the Science and Art Department for buildings be extended, under sufficient guarantees, so as to embrace institutions for scientific instruction, although they may not be built under the Public Libraries Act or be in connection with a school of art.

XVII. We recommend that grants similar to those now made for apparatus be given for laboratory and museum fittings under proper guarantees.

XVIII. We recommend that, whenever the arrangements for scientific teaching in any institution shall have attained a considerable degree of completeness and efficiency, such institution be recognised as a science school, and be so organised as to become the centre of a group of elementary science classes; and to provide the assistance of first grade science masters, the loan of apparatus and specimens, and the means of instruction in the laboratories and museums to the more advanced students of the group.

XIX. We recommend that assistance be given for the formation and maintenance of such science schools by special grants, the conditions of which shall be determined by regulations to be framed by the Science and Art Department.

XX. We recommend that when laboratories are attached to second grade grammar schools in the schemes issued by the Endowed Schools' Commissioners, the trustees of such schools be encouraged and enabled to invite the

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formation of elementary science classes, to be taught therein.

All of which we humbly beg leave to submit for Your Majesty's gracious consideration.

(Signed)

DEVONSHIRE.	W. SHARPEY.
LANSDOWNE.	G. G. STOKES.
JOHN LUBBOCK.	HENRY J. S. SMITH.
J. P. KAY-SHUTTLEWORTH.	*T. H. HUXLEY.
BERNHARD SAMUELSON.	

(* The Chairman has been authorised by Professor Huxley to affix his signature to this Report.)

J. NORMAN LOCKYER, Secretary.

March 22nd, 1872.

SUPPLEMENTARY REPORT TO FIRST REPORT.

TO THE QUEEN'S MOST EXCELLENT MAJESTY.

May it please Your Majesty,—We, the Commissioners appointed by Your Majesty to make inquiry with regard to Scientific Instruction and the advancement of Science, humbly beg leave to present to Your Majesty the follow- Report on the Organisation of the Science School referred to in our First Report, and on the accommodation of that School in the new buildings at South Kensington.

I. *Organisation.*

Your Commissioners recommend that the science school be represented before the Board of the Science and Art Department by its Dean, as the Royal School of Mines has been hitherto represented by its Director.

We recommend that the council of professors shall have power, subject to the approval of the Board, to provide for the due maintenance of discipline in the general school and technical schools; the discipline of the students of the Royal School of Naval Architecture and Marine Engineering remaining under the principal of that school.

We consider that such modifications as to the conditions of admission to the courses, as well as such re-arrangement of the courses as may be rendered expedient by the consolidation of the schools recommended in the First Report of the Commission, should be considered and reported on to the Committee of Council on Education by the Council of Professors, due regard being had to the maintenance of its character as a school for special scientific instruction. Such re-arrangement should admit of provision being made for the continuance and extension of the instruction given to elementary science teachers during the summer months.

With reference to the assistance required by the professors, we recommend that this subject should also be considered by the Council of Professors and reported on by them to the Committee of Council on Education, due regard being had to the necessity of practical instruction, and to the suggestion in the previous paragraph concerning the instruction to be given to science teachers.

II. *Accommodation.*

Your Commissioners find that the new buildings at South Kensington will afford sufficient space as regards lecture theatres, class rooms, and laboratories, for the theoretical and practical instruction of a large accession of students. A committee of your Commissioners have inspected the new buildings with special reference to the accommodation that will be afforded, and the Secretary, at their request, has applied to the several professors for information as to the space that they require.

The Committee having reported the results of their inspection and inquiry, your Commissioners suggest the following general appropriation, considering that the detailed allotment of rooms had better be left to the professors themselves:—

Basement ..	Physics, Metallurgy, Chemistry
Ground Floor..	School of Naval Architecture, General Lecture Room, Mathematics, Applied Mechanics, &c.
First Floor ..	Physics and Chemistry.
Second Floor ..	Chemistry.
Third Floor ..	Biology, Mineralogy, Mining, Geology, Physics, Chemistry (open air work).

All which we humbly submit for Your Majesty's gracious consideration.

(Signed)

DEVONSHIRE.	W. SHARPEY.
LANSDOWNE.	G. G. STOKES.
JOHN LUBBOCK.	HENRY J. S. SMITH.
J. P. KAY-SHUTTLEWORTH.	*T. H. HUXLEY.
B. SAMUELSON.	

(* The Chairman has been authorised by Professor Huxley to affix his name to this Supplementary Report.)

J. NORMAN LOCKYER, Secretary.

February 28, 1872.

CONTRIBUTIONS TO THE HISTORY OF THE OPIUM ALKALOIDS.*

By C. R. A. WRIGHT, D.Sc.,
Lecturer on Chemistry in St. Mary's Hospital Medical School.

PART V.

I. *On the Polymerides of Codeia.*

IN Part IV. of these researches reasons have been adduced for the following general conclusions, viz., that codeia and morphia are capable of forming polymerides (with the elimination of methyl in the case of codeia in some instances), which yield derivatives containing certainly not less than C_{68}, and probably not less than C_{136} (C_{72} and C_{144} in the case of those codeia derivatives where methyl has not been eliminated). Experiments now in progress tend to show that the formulæ of codeia and morphia are really double of those formerly ascribed to these bases, *i.e.*, are—

$$C_{36}H_{42}N_2O_6 \text{ and } C_{34}H_{38}N_2O_6$$

respectively, the proof of which is (as will be shown in a subsequent communication) that the first products of the action of hydrochloric acid on these bases appear to contain chlorine and carbon in the proportions C_{36} and Cl, C_{34} and Cl respectively, instead of C_{18} and Cl, or C_{17} and Cl. It might be anticipated, therefore, that intermediate polymerides might be formed containing respectively,—

Morphia series.		Codeia series.	
Monomorphia.. ..	$C_{36}H_{38}N_2O_6$ ..	$C_{36}H_{42}N_2O_6$	Monocodeia.
Dimorphia	$C_{68}H_{70}N_2O_{12}$ ..	$C_{72}H_{84}N_4O_{12}$	Dicodeia.
Trimorphia	$C_{102}H_{104}N_3O_{18}$ ..	$C_{108}H_{126}N_3O_{18}$	Tricodeia.
Tetramorphia.. ..	$C_{136}H_{138}N_2O_{24}$ ..	$C_{144}H_{168}N_4O_{24}$	Tetracodeia.

In the case of codeia these anticipations have been verified.

In order to obtain these supposed polymerides before their further alteration by secondary reactions, the action of acids other than the hydracids was examined. Acetic acid seemed a probable agent for this purpose; but no appreciable quantity of anything different from ordinary codeia was obtained after sixty-four hours' digestion at 100° of one part of this base with three parts of glacial acetic acid. On precipitation of the product by Na_2CO_3 in large excess, extraction with ether, and agitation of the ethereal extract with HCl, a crystalline mass was obtained which developed a smell of acetic acid on standing in contact with a slight excess of HCl; but on analysis this gave numbers agreeing with those required for codeia hydrochlorate, and from it nothing different from codeia could be obtained; probably, therefore, only a trace of acetyl-codeia was formed.

The action of phosphoric acid, however, was found to lead to the desired result without the formation of by-

* A Paper read before the Royal Society.

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products beyond colouring-matters formed by the high temperature employed; by heating codeia with 3 parts glacial phosphoric acid and 5 of water for several hours at 100°, no perceptible change is produced. The same result follows on boiling for twelve hours (boiling-point 105°) with an inverted condenser attached to prevent loss of water by evaporation; but if the boiling-point be allowed to rise slowly from evaporation, the mixture being very gently boiled in a long-necked flask, the product gradually acquires the power of giving an immediate amorphous precipitate with Na_2CO_3; no large amount of new substances are, however, formed until the boiling-point has risen to about 200°, beyond which point the evaporation cannot safely be pushed. The viscid chestnut-coloured liquid, while still hot, is dissolved in boiling water and allowed to cool; nothing separates on cooling; when cold, the liquid is nearly neutralised by caustic soda, and then precipitated with Na_2CO_3; the precipitate is collected on filters, drained from mother-liquors, dissolved in weak HCl, and re-precipitated by Na_2CO_3, to get rid of traces of unaltered codeia mechanically retained; finally, the drained precipitate is exhausted with ether. The ethereal solution yields on agitation with HCl a crystalline hydrochlorate, which may be purified by solution in water, fractional precipitation with Na_2CO_3 and repetition of the ether process, and, finally, by re-crystallisation of the resulting hydrochlorate.

The portion of the first Na_2CO_3 precipitate insoluble in ether is dissolved in HCl, and fractionally precipitated by Na_2CO_3, to remove colouring-matters as much as possible; the last precipitate, after thorough washing and drying, forms a light buff-coloured amorphous powder that does not soften at 100° when perfectly dry, but clots to a resinous mass if heated in the water-bath while still moist; it is soluble in alcohol, is precipitated from this solution on addition of ether, and yields salts that have no vestige of crystalline characters.

Both the crystalline and the non-crystalline hydrochlorates yield on analysis numbers identical with those required for codeia hydrochlorate; for the reasons developed in the subsequent sections, they are regarded as respectively di- and tetra-codeia.

The filtrate from the original Na_2CO_3 precipitate contains much unaltered codeia; by extracting with ether and agitation of the extract with excess of phosphoric acid solution, a mixture of phosphates is obtained, from which a further quantity of each polymeride is obtainable by simply boiling down the liquid till the boiling-point reaches 200°.

The hydrochlorate of tetracodeia obtained as above described forms a brownish brittle tar not fusible at 100° when dry; dried at 100° it yields the following numbers:—

Specimen A. 0·325 grm. gave 0·773 CO_2 and 0·186 H_2O.
" B. 0·3145 " " 0·732 " 0·185 "
0·1215 " " 0·0495 AgCl.

	Calculated.		Found. A.	Found. B.
C_{144}	1728	64·38	64·87	63·48
H_{176}	176	6·56	6·36	6·54
N_8	112	4·17		—
O_{24}	384	14·30		—
Cl_8	284	10·59		10·08
$C_{144}H_{168}N_8O_{24},8HCl$	2684	100·00		

The free base gave the following numbers:—

0·8095 grm. gave 0·818 CO_2 and 0·190 H_2O.

	Calculated.		Found.
C_{144}	1728	72·24	72·08
H_{168}	168	7·02	6·82
N_8	112	4·68	
O_{24}	384	16·06	
$C_{144}H_{168}N_8O_{24}$	2392	100·00	

In appearance and most physical properties tetracodeia and its salts bear a great resemblance to chloro- and bromo-tetracodeia; and they further agree in that all yield a blood-red colour on warming with silver nitrate and nitric acid, or with nitric acid alone; it differs from chloro-tetracodeia in that the aqueous solution of the hydrochlorate does not precipitate on the addition of strong HCl, the salt being apparently as soluble in diluted HCl as in water; also the free base does not oxidise so readily. In all respects tetracodeia agrees with the description given by Anderson of his "Amorphous Codeia"* obtained by the action of sulphuric acid on codeia; on comparison with the product obtained by Anderson's process, no essential differences could be detected between the two substances, except that the phosphoric acid product was somewhat darker in tint, owing no doubt to the presence of colouring-matters from the higher temperature employed in its production.

The hydrochlorate of dicodeia obtained as above described crystallises with $3H_2O$ for every C_{18} contained, this water of crystallisation being wholly lost at 100° and partially by standing over sulphuric acid.

	Grms. per cent.
2·163 grms. of crystals dried on filter-paper lost at 100°	0·295
Actual loss	= 13·63
Calculated for $C_{72}H_{84}N_4O_{12},4HCl+12H_2O$	= 13·86
2·012 grms. of crystals that had stood three days over SO_4H_2 lost, at 100°, 0·172	= 8·54

Dried at 100°, these crystals gave these numbers:—

0·306 grm. gave 0·719 CO_2 and 0·182 H_2O.
0·3135 " 0·742 " 0·194 "
0·229 " 0·098 AgCl.

	Calculated.		Found.	
C_{72}	864	64·38	64·08	64·54
H_{88}	88	6·56	6·61	6·88
N_4	56	4·17		—
O_{12}	192	14·30		—
Cl_4	142	10·59		10·60
$C_{72}H_{84}N_4O_{12},4HCl$	1342			

Na_2CO_3 throws down from the solution of the hydrochlorate white amorphous flakes that do not oxidise spontaneously in the air. Dried at 100°, 0·2965 grm. gave 0·7765 CO_2 and 0·189 H_2O.

	Calculated.		Found.
C_{72}	864	72·24	71·43
H_{84}	88	7·02	7·08
N_4	56	4·68	
O_{12}	192	16·06	
$C_{72}H_{84}N_4O_{12}$	1196	100·00	

If the solution of the hydrochlorate be concentrated, the addition of Na_2CO_3 solution throws down tarry globules consisting of a mixture of the base and its hydrochlorate, the salt being sparingly soluble in the NaCl solution formed by the decomposition.

Dicodeia and its salts do not yield a blood-red colour with NO_3H, only a slight orange tint; Fe_2Cl_6, also—

$$SO_4H_2+K_2Cr_2O_7,$$

give no colour reactions.

In general properties, and in the fact that water of crystallisation possessed by the hydrochlorate is lost at 100°, dicodeia bears a great resemblance to the "isomer of codeia" obtained by Drs. Matthiessen and Armstrong by the action of diluted sulphuric acid on codeia.† On comparison with the product obtained by Armstrong's process, no difference whatever was discernible provided the hydrochlorate obtained by the action of sulphuric acid, &c., were several times re-crystallised; the crude hydrochlorate contains, besides the dicodeia salt, the hydrochlorate of another polymeride, which differs from dicodeia

* Anderson, *Ed. Phil. Trans.*, vol xx. (1), p. 57.
† *Journal of the Chemical Society* (ii.) vol. ix., p. 58.

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hydrochlorate in that it is non-crystalline, drying up to a gummy, extremely hygroscopic and deliquescent substance; it yields a blood-red colour with NO_3H, and with—

$$SO_4H_2 + K_2Cr_2O_7$$

a very evanescent purplish-red; Fe_2Cl_6 gives no colouration at first, but on standing, a reddish-purple tinge appears, gradually becoming more intense. Na_2CO_3 throws down an amorphous white precipitate, which is soluble in ether, and but little changed by exposure to air. From these properties, which seem to be analogous in some respects to dicodeia, in others to tetracodeia, the base is considered to be intermediate between these two polymerides, *i.e.*, to be *tricodeia*. The crude hydrochlorate of dicodeia obtained by Armstrong's process on re-crystallisation furnished mother-liquors which, on standing over SO_4H_2 for several weeks, gradually deposited crystals, and finally became a crystalline mass wetted with a viscid non-crystalline liquid; by gentle pressure in filter-paper the liquid portion was separated from the crystals, which were found to be only dicodeia hydrochlorate; and finally, the treacly hydrochlorate of tricodeia was extracted from the papers by water. On repetition of the treatment over SO_4H_2, no crystals were obtained even after several weeks' standing; at 100° a brittle, gummy, hygroscopic substance was obtained, of which—

0·309 grm. gave 0·730 CO_2 and 0·191 H_2O.
0·208 „ 0·0895 AgI.

	Calculated.		Found.
C_{108}	1296	64·38	64·43
H_{132}	132	6·56	6·87
N_6	84	4·17	—
O_{18}	288	14·30	—
Cl_6	213	10·59	10·64
$C_{108}H_{126}N_6O_{18},6HCl$	2013	100·00	

II. *Action of Hydrochloric Acid on the Polymerides of Codeia.*

(*a*). *Tetracodeia.*—Tetracodeia hydrochlorate was boiled for six hours with a large excess of strong HCl; no perceptible evolution of methyl chloride took place; and on examining the resulting product no change was found in the ratio of carbon to chlorine. Hence no substitution of Cl for OH had taken place, and apparently no action at all had ensued.

(*b*). *Tricodeia.*—Tricodeia hydrochlorate was heated to 100° for 1½ hours with a large excess of strong HCl; on adding water to the product, a tarry substance was precipitated, whereas the original tricodeia hydrochlorate is readily soluble in dilute HCl; precipitated by Na_2CO_3, and the precipitate exhausted with ether, a viscid non-crystalline hydrochlorate was obtained on agitation of the ethereal extract with HCl. The reactions of this product appear to be identical with those of tricodeia, excepting that the reddish-purple tinge with Fe_2Cl_6 appears instantaneously instead of only after standing a short time. Dried at 100°,

0·3070 grm. gave 0·756 CO_2 and 0·185 H_2O.
0·2480 „ 0·1150 AgCl.

	Calculated.		Found.
C_{108}	1296	68·03	67·16
H_{120}	120	6·30	6·69
Cl_6	213	11·18	11·48
N_6	84	4·41	
O_{12}	192	10·08	
$C_{108}H_{114}N_6O_{12},6HCl$	1905	100·00	

Hence this product has been formed by the reaction—

$$C_{108}H_{126}N_6O_{18},6HCl = 6H_2O + C_{108}H_{114}N_6O_{12},6HCl,$$

and has the composition of a polymeride of "apocodeia." From the great similarity observed between this product and "apocodeia" made by Matthiessen and Burnside's process*, it appears probable that the product of the action of zinc chloride on codeia is a mixture of bodies of general formula $(C_{18}NH_{19}O_2)_n,nHCl$, in which the derivative where $n=6$ greatly predominates; experiments on the action of zinc chloride on morphia now in progress in conjunction with Herr L. Mayer indicate that mixtures are obtained in this case also.

(*c*). *Dicodeia.*—When pure dicodeia hydrochlorate is heated to 100° for one hour with a large excess of HCl, a change is produced expressible by the equation—

$$C_{72}H_{84}N_4O_{12},4HCl + HCl = C_{72}H_{83}ClN_4O_{11},4HCl + H_2O,$$

which shows that the formula of this polymeride contains at least C_{72}. Na_2CO_3 throws down from the product a voluminous white precipitate, which differs in appearance slightly from that of dicodeia, and turns green by exposure to air; ether dissolves this precipitate, and on agitation with HCl a viscid hydrochlorate is obtained which does not crystallise, but dries up to a gum. Fe_2Cl_6 gives a brown-purple tint, NO_3H a blood-red, and—

$$K_2Cr_2O_7 + SO_4H_2$$

a lighter blood-red, none of which reactions occur with the original dicodeia. Dried at 100°,

0·3200 grm gave 0·737 CO_2 and 0·189 H_2O.
0·3260 „ 0·172 AgCl.

	Calculated.		Found.
C_{72}..	864	63·50	62·82
H_{87}	87	6·39	6·56
Cl_5	177·5	13·04	13·06
N_4..	56	4·12	
O_{11}	176	12·95	
$C_{72}H_{83}ClN_4O_{11},4HCl$	1360·5	100·00	

(To be continued).

* *Proc. Roy. Soc.*, vol. xix., p. 71.

ON A DOUBLE CHLORIDE OF NICKEL AND AMMONIUM.

By ISAAC ADAMS, Jun., and J. M. MERRICK.

THE literature of the double salts of cobalt and nickel with alkalies is rather scanty. We subjoin some notes upon the double chloride of nickel and ammonium, a salt which we have still under examination.

Tuffuti (*Ann. de Chimie*, vol. lxxviii., p. 169), speaking of this double salt, says, "since we are not able to wash it properly, by reason of its solubility, and since it does not crystallise regularly, I dare not affirm with certainty its existence." Tuffuti's salt was made by mixing chloride of nickel with sal-ammoniac.

Hautz (*Ann. der Chem. u. Pharm.*, vol. lxvi., p. 283) says that "by Tuffuti's method are obtained crystals in the form of star-like twins, which are composed of heaps of tetrahedrons whose analysis shows a small amount of nickel, varying according to the lighter or darker yellow colour of the stars. This salt varies in accordance with the density of the liquid from which it is crystallised.

We were ignorant of Hautz's researches—any farther than they are noticed in Gm. Eng. Ed., vol. v., p. 383, when we began our experiments, which had for their end the preparation of a tolerably pure double chloride of nickel and ammonium.

Our salt was prepared as follows, viz.:—

Equivalent amounts of pure, re-crystallised, and air-dried double sulphate of nickel and ammonia, and chemically pure fused chloride of barium dried over sulphuric acid, were weighed out, dissolved, the solutions mixed, the sulphate of baryta filtered off, and the green filtrate made to crystallise over sulphuric acid at the ordinary temperature under the bell-jar of an ordinary air-pump.

After three weeks, a large amount of barley-candy coloured crystals were obtained, looking like grains of wheat stuck together in stellate forms—probably Hautz's "stern-formigen Zwilligen"—whose aspect was so curious,

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especially as we expected to obtain bright green prismatic crystals, that we immediately made some analyses of the crystals, after washing them with cold water and drying at the temperature of the air.

The yellow salt can likewise be obtained in large stellate clusters, and quite free from lemon-yellow cubes, by evaporating a large amount of the solution obtained by double decomposition to about 30° Beaumé, and allowing it to cool very slowly.

The yellow crystals are soluble in about 2 parts of water at 100° C.

The nickel was determined as such in the following way:—

A quantity of the salt was weighed in a bright platinum crucible, and therein dissolved in a very little hot water, and a few drops of ammonia added. The crucible was then made the cathode of a galvanic circuit, and being covered with a perforated porcelain cover, the anode—a slip of platinum—was lowered through the hole in the cover so as just to dip into the liquid, and the circle was thus completed. About two hours was found sufficient to deposit—with two medium Grove's cells—all the nickel from ½ or ⅔ grm. of the salt.

The chlorine was determined as chloride of silver, &c.

The air-dried salt was found to contain just 1 per cent of mechanically-combined water, and the following results are corrected for that amount:—

(*a*). 1 grm. of yellow salt, dried at 100° till a constant weight was attained, gave 0·99 grm. of dry salt = 1 per cent loss, or water.

(*b*). 0·5 grm. of yellow salt gave 1·2237 grms. of chloride of silver = 0·3022 grm. of Cl = with 1 per cent correction, 61·07 per cent.

(*c*). 0·25 grm. of yellow salt gave 0·626 grm. of chloride of silver = 0·1545 of Cl = with 1 per cent correction, 62·41.

(*d*). 0·2 grm. of yellow salt gave 0·195 grm. of Pt = 0·0355 of NH_4 = with 1 per cent correction, 17·92 per cent.

(*e*). 1·0775 grms. of yellow salt gave 0·069 grm. of metallic Ni = with 1 per cent correction, 6·49 per cent.

(*f*). 1·136 grms. of yellow salt gave 0·0735 grm. of metallic Ni = with 1 per cent correction, 6·47 per cent.

(*g*). 0·4255 grm. of yellow salt gave 0·0265 of metallic Ni = with 1 per cent correction, 6·30 per cent nearly.

(*h*). 0·413 grm. of yellow salt gave 0·026 grm. of metallic Ni = with 1 per cent correction, 6·35.

In (*g*) and (*f*) the same yellow crystals were used as in the other determinations, but the corked tube containing them had lain in the sun, and some water having been observed to be liberated, the tube was repeatedly shaken, to re-distribute, if possible, this moisture; and its unequal distribution probably makes the percentage of nickel vary.

In another experiment, 2 atoms of anhydrous chloride of nickel were dissolved with 1 atom of pure chloride of ammonium, and the green solution crystallised over oil of vitriol.

It gave a cake of crystals in two layers firmly united; the lower, the yellowish, confused tetrahedrons, and the upper, larger confused prisms, of an emerald green colour. The whole was crushed between filter-paper, and the green crystals separated mechanically as far as possible.

An analysis of the green crystals resulted as follows, viz.:—

(*i*). 0·3205 grm. of green crystals gave 0·0535 grm. of metallic nickel = 17·0 per cent.

The liquid from the above determination, and free from nickel, was evaporated to dryness on the water-bath. to determine directly the amount of chloride of ammonium present.

Assuming that in the deposition of the metal there was no loss of chlorine as hypochlorous acid, which seems *impossible, as the solution was kept strongly alkaline with* ammonia, this method should give the chloride of ammonium with exactness.

(*j*). 0·3205 grm. of green crystals gave 0·1335 grm. of NH_4Cl = 41·71 per cent − 0·098 due to the NiCl = 38·56 per cent.

Hautz's formula for the double chloride of nickel and ammonium, $NH_4Cl,2NiCl,12HO$, calculated with more recent atomic weights than he used, requires 19·10 per cent of chloride of ammonium and 19·96 per cent of nickel (an amount of metal which was very nearly reached in another sample of the green salt which we prepared).

In another experiment, the green salt was freed from the mechanically-adhering yellow crystals, dried between blotting-paper, and then for half an hour over sulphuric acid. It gave as follows, viz.:—

(*k*). 0·4515 grm. of green salt gave 0·088 grm. of nickel = 19·49.

(*l*). 0·572 grm. of green salt gave 0·111 grm. of nickel = 19·40.

(*m*). The liquid in analysis (*l*), freed from nickel, was evaporated in a water-bath, and dried alternately in the water-bath and over sulphuric acid until a constant weight was obtained.

0·572 grm. of green crystals gave 0·3295 grm. of chloride of ammonium, which, less 0·2105 grm. due to the chlorine of the chloride of nickel, gives 0·119 grm. = 0·04 grm. of ammonium = 6·97 per cent.

Hautz's formula requires 6·19 per cent.

(*n*). 0·313 grm. of green crystals gave, by battery process, 0·0595 grm. of metallic Ni = 19·0 per cent.

(*o*). 0·3025 grm. of green crystals, dried at 100° C. until a constant weight was obtained, lost 0·110 grm. of water = 36·36 per cent.

Hautz's formula, reckoned with the more recent atomic weights, requires 37·17 per cent.

Our results with the better sample of the green salt may be compared with Hautz's figures and the theoretical percentages, as follows, viz.:—

		Theory.	Hautz.	A. and M.		
2Ni	58·0	19·96	20·05	19·71	19·40	19·00
3Cl	106·5	36·66	36·44			
NH_4	18·0	6·20	5·65	6·97		
12HO	108·0	37·18	37·86	36·36		
	290·5	100·0	100·00			

It is hardly possible to doubt the identity of the two salts.

As these yellow tetrahedrons, of a form at once remarkable and striking, were obtained several times—every time, in fact, that we attempted to make a double chloride of nickel and ammonium—we were led to believe that they must have a fixed composition, and we therefore essayed to construct a formula from our analyses.

A salt containing 1 atom of nickel, 8 of chlorine, 4 of ammonium, and 7 of water, would have percentages as shown below, which may be compared with the results of our analyses, viz.:—

			Theory.	A. and M.			
Ni	= 29	=	6·47	6·49	6·47	6·30	6·35
8Cl	= 284	=	63·39	61·07	62·41		
$4NH_4$	= 72	=	16·08	17·92			
7HO	= 63	=	14·06	14·52			
	448		100·00	100·00			

We have not been able to construct from these figures any satisfactory rational formula.

When this yellow salt is dissolved in water and recrystallised, it gives crystals in the form of cubes, pale straw-yellow, and which give on analysis only about 1·5 per cent of metallic nickel. The tetrahedrons sometimes occur mixed with these pale yellow cubes, from which they can be readily separated mechanically.

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We have examined samples of a commercial double chloride of nickel and ammonium (so-called) since making the preceding experiments.

It consists of masses of the barley-candy coloured stellate tetrahedrons, mixed with greenish-yellow confused crystals of another form and some chloride of ammonium. There can be no doubt that these tetrahedrons are the salt we have analysed, or that they are mixed with some other salt, perhaps Hautz's chloride.

Hautz's paper, which is entitled "Ueber einige isomorphe Doppelsalze des Chlorammoniums mit Chlormetallen aus der Magnesium-reihe," is written to show that there exist two series of salts, viz.:—

$NH_4Cl, 2CoCl, 12HO.$
$NH_4Cl, 2NiCl, 12HO.$
$NH_4Cl, 2MgCl, 12HO.$

and

$NH_4Cl, 2MnCl, 4HO.$
$NH_4Cl, 2ZnCl, 4HO.$
$NH_4Cl, 2CuCl, 4HO.$

It does not treat of nickel especially. It is significant that Hautz had difficulty in preparing both the magnesium and the nickel salt, owing, as he says, to the tendency of the sal-ammoniac to crystallise out by itself, or with very small percentages of metal.

He also had trouble in obtaining the double cobalt salt, which, as well as some curious double bromides, we are now investigating.

Hautz describes the cobalt salt ($NH_4Cl, 2CoCl, 12HO$) as "Schöne rüben-rothe—prachtvolle," which is probably the case; but there is no question, theoretically, that a cobalt salt corresponding to the yellow nickel tetrahedrons would be *blue*.

We cannot help adding one word in regard to determining metals by the battery. It seems to us that, so far as our experience goes, this elegant method is not so much used as its merits deserve. Take, for example, nickel. A very eminent chemist tells us that he calls it good work when his best pupils make their nickel determinations, made in the ordinary way, agree within one-half of 1 per cent. On the other hand, with ordinary care, the determinations made by depositing nickel on platinum should never vary except in the second decimal place.

In fact, with the same solution, it is hard to make them vary more than a few hundredths of a per cent. This method has been often set forth as excellent, but it deserves a wider use and application than it now enjoys.—*American Chemist.*

ESTIMATION OF NITROGEN BY COMBUSTION.

By JOHN RUFFLE.

In making determinations of nitrogen by combustion with soda-lime, and conversion of the nitrogen into ammonia, some anomalous results recently obtained have induced me to make some experiments, the results of which show that not only is the nitrogen present in a substance as salts of ammonia, albuminous matters, &c., determinable, but the nitrogen present as a nitrate can be made to show in analysis. In nitrogen combustions as often performed, the nitrogen present as a nitrate is partially determined, in addition to the nitrogen present as ammonia, &c. I find that, by modifications of the present way of conducting a nitrogen combustion, about 80 per cent of the nitrogen present in a substance as nitrate can be determined, whether present in conjunction with ammoniacal salts or alone. Results obtained by experimenting with a simple nitrate have, under certain circumstances, yielded me as much as 94 per cent of the nitrogen converted into ammonia, and warrant the inference that by careful research it will be possible to determine by combustion the whole of the nitrogen present as a nitrate in addition to the nitrogen otherwise contained.

The advantages of a process that will enable one to determine the nitrogen present as nitrate will be most apparent in agricultural chemistry, where the principal sources of nitrogen (as a manure) are Peruvian guano, sulphate of ammonia, and nitrate of soda; the market value of these rule the prices of all other sources of nitrogen, but the nitrogen in the shape of Peruvian guano (at its present quality) or sulphate of ammonia is approximatively 20 per cent dearer than that of nitrate of soda, and is also more limited in supply. If we are able to readily determine the nitrogen present in manures as nitrates, it is evident that nitrate of soda, an acknowledged valuable fertilising agent, may, with advantage to the farmer, be employed by manure manufacturers where it is now passed over, because it is not estimated by ordinary analysis.

This conversion of the nitrogen of nitrates into ammonia by "combustion" is one not in accordance with text-books, and I shall be glad if your correspondents will inform me of any analysis (if such exist) pointing in the same direction.

2, Church Villas, Church Street,
Plaistow, E.

CORRESPONDENCE.

ORIGINAL RESEARCH.

To the Editor of the Chemical News.

Sir,—All who take an interest in the progress of science must feel greatly indebted to Dr. Frankland for so eloquently pleading, at the last Anniversary Meeting of the Chemical Society, for the *recognition* of original research.

A man knows that if he can only manage by *coach* or *cram* to partially answer some of a series of so-called test-questions, he will receive such recognition as will help him better to engage in the struggle for existence: this is his incentive, and the cause of an enormous amount of encyclopædic work being done. But while hosts are labouring at this species of work, Nature waits investigation—she offers a rich harvest to all willing to take up her cause, but labourers slowly enter her fair fields, not so much from want of inclination or power of doing the higher kind of work as from the absence of the above-mentioned incentive. It may be argued that the Fellowship of the Royal Society is a recognition of original research: as a rule it may, perhaps, be so considered, but the power of influence, and the heavy costs pertaining to the honour, must always prevent it from acting as a general incentive to investigation.

It might be wished that existing examining bodies would take the initiative in this matter. When, however, a reform is required, it is almost useless to attempt to get help where invested interests are concerned, especially when the possessors of such are incapable of understanding the spirit of the reform demanded. To petition our Universities would be, in the present science period, waste of much energy and cause of delay. Why cannot the recognised societies take the initiative? Why, for example, cannot the Chemical Society, taking cognizance as it does of physical and general chemistry, confer some distinction on its Fellows who distinguish themselves in some branch of that science. Alarmists and possessors of invested interests will say it would cause the disruption of the Society. I firmly believe that it would be the means of adding to its prosperity and usefulness, and do as much for our science as has been done by Dalton's grand conception of the atomic constitution of matter.—I am, &c.,

A. T.

April 9, 1872.

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MISCELLANEOUS.

The Royal Polytechnic.—We understand that the Professorship of Chemistry at this Institution has been accepted by Professor Gardner, F.E.S. The laboratories and chemical theatre will be well filled with all the accessories necessary for a school of science, and such measures taken as will render the scientific department a valuable part of the Institution.

Piperidine from Amyl Derivatives.—We are informed by our Glasgow correspondent that Dr. T. E. Thorpe, in conjunction with Mr. M. M. Pattison Muir, F.C.S., has for some time been engaged in conducting an experimental inquiry with the object of obtaining piperidine, one of the active principles of pepper, from amyl derivatives. The experiments are still in progress, and this preliminary notice of them is made on account of the fact that certain German chemists are engaged in a research which seems to tend in a similar direction.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, March 25, 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Three Memoirs Containing Observations on the means of Preserving, Keeping in Sound State, and Improving, as well as Maturing, Wine.—Respectively by M. de Vergnette-Lamotte, M. Pasteur, and Dr. Thenard.

Injury Caused by Lightning at Alatri (Italy) by Falling on a Lightning-Rod.—Rev. A. Secchi, S.J.—In a letter from Rome, dated March 20, the eminent *savant* gives a detailed account of the very curious effects of lightning which struck a lightning-conductor and, having in a great measure destroyed it, pursued its way along water-pipes, some of which were also destroyed.

Absorption-Spectrum of the Vapours of Sulphur.—G. Salet.

New Class of Combinations of Dulcite with Hydracids.—G. Bouchardat.—The author describes the following compounds:—Chlorhydrate of dulcite, $C_{12}H_{14}O_{12}+HCl+3H_2O_2$, a very unstable crystalline body; it can only be kept in an atmosphere saturated with hydrochloric acid, and is destroyed even by very cold water, dulcite being left. Bromhydrate of dulcite, $C_{12}H_{14}O_{12}+HBr+3H_2O_2$; also an unstable crystalline body, but less readily decomposed than the foregoing. Iodhydrate of dulcite, $C_{12}H_{14}O_{12}+HI+3H_2O_2$, like the two foregoing a solid very unstable crystalline compound, is prepared like them by cautiously bringing dulcite into contact with the hydracids alluded to. The author says it would appear that all these compounds correspond to a hydrate of dulcite, $C_{12}H_{14}O_{12}+4H_2O_2$, which he has not been able to obtain.

Action of Bromine upon Protochloride of Phosphorus.—M. Prinvault.—When protochloride of phosphorus is added to bromine a very violent reaction ensues, but when bromine is added to the protochloride the action is far more calm, and there is gradually formed a compound which, after the excess of bromine has been eliminated, is found on analysis to be composed of PCl_3Br_2, which may be written PBr_2ClBr, a solid crystalline body, soluble in sulphide of carbon, and also somewhat soluble in protochloride of phosphorus, but decomposed by water, yielding bromine and phosphoric, chlorhydric, and bromhydric acids. The author further details at great length the results of his experiments with various reagents on this body, and the action of a temperature above 90° upon it.

Observations on the Mineral Matter of Plants.—A. Baudrimont.—Since Dr. Sacc recently stated that no chemical relation exists between the organic matter of plants and the ash they contain, the author first wrote to Dr. Sacc on this subject, but the latter persisting in his opinion, and quoting in support thereof the fact that several plants (especially those belonging to the *Cactus*, aloe, sedum, and *Opuntia* tribes) grow vigorously on bare rocks, the author has undertaken a series of analyses, especially with such kinds of plants, with the view to prove—(1) That all plants contain mineral matter (although in some—for instance, the *Cactus Peruvianus*—this quantity is very small indeed, since that plant contains upwards of 95 per cent of water, leaving only 5 per cent for organic and inorganic matter together) (2) that this mineral matter is either simply held in solution in the vegetable juice or fixed by the organic matter, but only as an adhesive union with the fundamental structure of the organic products.

Among the natural history and meteorological papers contained in this number we call attention to a memoir on—

Gonolobus Cundurango.—M. Triana.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 6, 1872.

This number contains the following original papers and memoirs:—

Composition of Diphenine.—Julie Lermontoff.—In the introduction to this memoir the authoress gives, first, a review of the labours of Gerhardt and Laurent (twenty-five years ago) on diphenine, discovered by them and formulated $C_{12}H_{12}N_4=C_{12}H_6(H_2N)_2N_2$, and then quotes briefly Dr. A. W. Hofmann's researches (*Proc. Roy. Soc.*, vol. xii., p. 644) on this subject. The researches of the authoress were made with the view to ascertain whether or not the diphenine of Gerhardt and Laurent is a hydro-compound, for which purpose the pure body was prepared exactly as directed by the discoverers; on being analysed, the diphenine led to the formula $C_{12}H_{10}N_2$, thereby proving it to be a hydro-compound, which combines with acids, yielding well-crystallised salts, the formula of the hydrochlorate being $C_{12}H_{14}N_4.2HCl$. This essay further treats on the results of the action of hydrosulphuret of ammonium when cold upon dinitro-azobenzol (when the reagent just named is used hot, diphenine is formed); there is formed another body, insoluble in water, difficultly soluble in boiling alcohol, not combining with acids, fusing at 220°. When binitro-azobenzol is similarly treated with hydrosulphuret of ammonium in the cold, hydro-dinitro-azobenzol is formed; formula—

$$C_{12}H_{10}N_4O_4=C_{12}H_8(NO_2)_2N_2H_2.$$

Benzidine.—J. Strakosch.—The contents of this memoir record the researches made with the view of obtaining an amidated benzidine, and the author describes, first, the mode of preparation of acet-benzidine—

$$\begin{matrix} C_6H_4.NH(C_2H_3O) \\ | \\ C_6H_4.NH(C_2H_3O) \end{matrix}$$

a solid crystalline body, insoluble in water, but somewhat readily soluble in boiling alcohol and ether, fuses at 300°, may be sublimed, but only with partial decomposition; dinitro-acet-benzidine—

$$\begin{matrix} C_6H_3(NO_2).NH(C_2H_3O) \\ | \\ C_6H_3(NO_2).NH(C_2H_3O) \end{matrix}$$

a solid crystalline sublimable body, insoluble in water, readily soluble in boiling alcohol; dinitro-benzidine—

$$\begin{matrix} C_6H_3(NO_2).NH_2 \\ | \\ C_6H_3(NO_2).NH_2 \end{matrix}$$

a solid red-coloured crystalline substance, sublimable above 300°; the attempts made to amidate these bodies failed. As an appendix there is added to this memoir a record on the sulphide of carbon combination of benzidine—

$$\begin{matrix} C_6H_4.NH \\ | \quad \diagdown \\ \quad\quad >C_6 \\ | \quad \diagup \\ C_6H_4.NH \end{matrix}$$

Contribution to our Knowledge of the Ethylen Bases.—Dr. A. W. Hofmann.—This exhaustive memoir is divided into the following sections:—Action of sulphide of carbon upon ethylen-diamine; ethylen-diamine-sulpho-carbonate, $C_2H_8N_2S_2=(C_2H_4)H_4N_2.CS$; ethylen-sulpho-carbamide or ethylen-sulpho-urea—

$$C_3H_6N_2S=\left\{\begin{matrix} CS \\ C_2H_4 \\ H_2 \end{matrix}\right\}N_2$$

salts of that compound; hydro-sulpho-cyanate of ethylen-diamine, $C_4H_{10}N_4S_2=(C_2H_4)H_4N_2.(HCNS)_2$; ethylen-diamides; action of benzoyl-chloride upon ethylen-diamine; ethylen-dibenzoyl-diamide—

$$C_{16}H_{16}N_2O_2=\left\{\begin{matrix} C_2H_4 \\ (C_7H_5O)_2 \\ H_2 \end{matrix}\right\}N_2$$

action of chloral upon ethylen-diamine; ethylen-diformyl-diamide $(C_2H_4)H_4N_2+2[CCl_3.CHO]=(C_2H_4)(CHO)_2H_2N_2+2CHCl_3$; action of oxalic acid ether upon ethylen-diamine.

Oxidation of Phenol.—H. Wichelhaus.—This paper, as yet only a preliminary communication, contains the results of the author's researches made for the purpose of studying the action of oxidising substances upon phenol. By treating phenol with chromic acid, and purifying the crude product, there was obtained, as first product of the oxidation of phenol, chinon, and also a compound of phenol and chinon, pheno-chinon, which is not further acted upon by chromic acid at the ordinary temperature.

Action of some Amido-Compounds upon Chloral.—O. Wallach.—The contents of this excellent and lengthy memoir are divided into the following sections:—Action of aniline upon chloral; action

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of toluidine upon chloral; formation of trichloracetic acid from chloral.

On Dichlorhydrine.—A. Watt.—The main gist of this paper is that the observation made by Hübner and Müller (*Ann. d. Chem. u. Pharm.*, vol. clix., p. 168), concerning the formation of two isomeric dichlorhydrines when dichlorhydrine is made by Berthelot's process, is not correct, the author having made a series of experiments to test this point. The paper also contains a short notice on the oxidation of dichlorhydrine.

Drying of Gases.—J. Myers.—We much regret that the contents of this exhaustive and lengthy essay, highly valuable in a scientific point of view, do not admit of useful abstraction. The author calls attention to the fact, accidentally discovered by him, that when so-called dry gases (dried by the best possible means) are caused to pass through boiling sulphur, that substance will give the means of detecting the presence of water in gases which do not chemically act upon sulphur under these conditions.

Description of Lecture Experiments on the Phenomena of Diffusion and for Exhibiting the Specific Gravity of Gases.—F. Fischer.—Illustrated with woodcuts.

On Chinamine, a New Cinchona Alkaloid.—O. Hesse.—While engaged in testing samples of the bark of the *Cinchona succirubra*, now largely exported from British India, the author found therein relatively much chinidine, some quinine, and among other alkaloids one which he terms chinamine, a well-crystallised substance, not containing any water of crystallisation, readily soluble in ether, in warm alcohol, and in petroleum ether (refined benzoline), and insoluble in water, in ammonia, and in caustic potassa; the alcoholic solution exhibits an alkaline reaction. With acids, this alkaloid forms salts, which are readily soluble in water; the chlorhydrate is an amorphous substance, and the neutral sulphate is difficultly obtained crystalline. Chinamine does not exhibit fluorescence of its solutions, and with chlorine and ammonia does not yield the well-known reaction of quinine; in strong sulphuric acid, chinamine dissolves without giving rise (unless heat be applied) to a colouration of that acid; when dissolved in nitric acid, the latter is first turned yellow by the chinamine, and next orange-red, after which the colouration disappears. Chinamine fuses at 172°; it is hardly bitter-tasted by itself, but its salts are somewhat so. The results of an elementary analysis of this new alkaloid will be made public as soon as the author shall have prepared a larger quantity of this material.

Some of the Derivatives of Cymol.—F. Landolph.—Mono-brom-cymol—

$$C_6H_2Br\left\{\begin{matrix}CH_3\\C_3H_7\end{matrix}\right.$$

is a colourless fluid, boiling at from 228° to 229°; sp. gr. = 1·269; by oxidation with nitric acid this compound yields bromo-toluylic acid—

$$C_6H_2Br\left\{\begin{matrix}CH_3\\CO_2H\end{matrix}\right.$$

a solid crystalline body, readily soluble in dilute hot alcohol, ether, and chloroform, but difficultly soluble in water; it fuses at 203° to 204°, and forms readily-crystallisable salts with calcium and barium. When this acid is treated with very concentrated and hot nitric acid, brom-nitro-toluylic acid is formed—

$$C_6H_2(NO_2)Br\left\{\begin{matrix}CH_3\\CO_2H\end{matrix}\right.$$

also a solid body, difficultly soluble in water, but readily so in alcohol ether, and benzol; before becoming fused at between 170° and 180° this substance is decomposed.

Benzyl-Sulpho Acid.—G. Barbaglia.—Notwithstanding the very high scientific merits of this memoir, it is not suited for useful abstraction, on account of requiring the reproduction of lengthy and complex formulæ.

Preparation of Propargyl Ether.—L. Henry.—By heating upon a sand-bath a flask containing mono-brom-ethyl-allyl ether—

$$(C_2H_4Br)C_3H_5O,$$

along with a very concentrated solution of caustic potassa in alcohol, the author obtained propargyl ether, which has been fully described as regards its properties by Liebermann and Krétschmer (*Ann. d. Chem. u. Pharm.*, vol. clviii., p. 237). The quantity of this ether obtained from 100 grms. of mono-brom-ethyl-allyl ether is about 45 grms. Sp. gr. of propargyl ether at 7° = 0·83; boiling-point, 81° to 85°.

New Product of Decomposition of Commercial Aniline.—R. Braun and Ph. Greiff.—The authors observed that when a large quantity of commercial aniline is distilled along with lime, the last portion of the distillate is not quite freely soluble in hydrochloric acid; further investigation led to the conclusion that the properties of that substance agree with those of carbazol, as described by Graebe and Glaser. Carbazol is present in crude tar oil, but the authors surmise that this substance might be formed by the drying of the mixture of aniline and lime in contact with the very hot metal of the iron still.

Some of the Derivatives of Tetra-Phenyl-Ethylen.—A. Behr.—The author describes at length, and elucidates with some lengthy and complex formulæ, the properties and mode of preparation of—Tetra-phenyl-ethylen oxide, $C_2(C_6H_5)_4O$; tetra-phenyl-ethylen-tetra-sulpho acid; tetra-oxy-tetra-phenyl-ethylen, $C_2(C_6H_4OH)_4$.

Combinations of the Aldehydes with the Phenols.—A. Baeyer.—The author describes in this paper a series of compounds resulting from the reaction of pyrogallic acid upon essential oil of bitter almonds, whereby a solid substance is formed, the formula of which is—

$$C_{20}H_{12}O_7=2C_7H_6O+2C_6H_6O_3=C_{34}H_{32}O_7+H_2O.$$

A combination of the essential oil of bitter almonds with naphthol is—

$$C_{24}H_{18}O_2=2C_7H_6O+2C_{10}H_8O=C_{34}H_{28}O_2+H_2O.$$

(1). $C_6H_5.CH_2$. $C_6H_4(OH)$, benzylated phenol.
(2). $C_6H_5.CH(OH)C_6H_4(OH)$, hypothetical aldehyde compound.
(3). $C_6H_5.CO$. $C_6H_4(OH)$, benzoylated phenol.

Simple Mercurial Valve.—H. Karsten.—The description, illustrated by a woodcut, of a very efficient and simple mercurial valve for use in various experiments.

Diphenylamine.—Drs. Merz and Weith.—Preliminary communication. The authors treat on a mono- and di-sulpho acid of this base, on the action of oxidising substances upon it, and on acetyl-diphenylamine; and incidentally mention that Dr. E. Kopp uses diphenylamine as a very sensitive test for the detection, as well as quantitative estimation, of nitrous and nitric acids in commercial sulphuric acid.

So-called Leaden Chamber Crystals as a Source of Pure and Cool Nitrous Acid.—M. Streiff.—Since it is well known that the crystals alluded to are, in contact with water, decomposed according to the following formula:—

$$SO_2\begin{matrix}<^{NO_2}\\<_{OH}\end{matrix}+H_2O=H_2SO_4+HNO_2$$

$$2(HNO_2)=N_2O_3+H_2O$$

yielding nitrous acid, the author prepares artificially a mixture (solution) of these crystals by passing sulphurous acid gas in red fuming nitric acid (kept very cold by ice or a freezing mixture), until an oily liquid is obtained; this solution, being poured into a suitable gas-evolving apparatus, yields, by the gradual addition of water, nitrous acid gas.

Analysis of Koumis made at Davos (Canton des Grisons, Switzerland).—Suter-Naef.—Sp. gr. of the fluid at 50° = 1·1286. In 100 grms. are contained—Water, 90·346; alcohol, 3·210; lactic acid, 0·190; sugar, 2·105; albuminates, 1·860; butter, 1·780; inorganic matter, 0·509; free carbonic acid, 0·177.

Action of Essential Oil of Mustard upon Milk.—Dr. Schwalbe.—One drop of the oil alluded to added to 20 grms. of milk prevents the latter being coagulated, even in hot summer weather, for several weeks, but the constituents of the milk so treated become altered, the casein becomes converted into albumen coagulable by heat, and this coagulum is difficultly soluble in concentrated hydrochloric acid; ether precipitates this albumen, but dilute acetic acid does not produce coagulation. The milk became very sour; it would appear that the casein is oxidised.

La Revue Scientifique de la France et de l'Etranger, March 30, 1872.

This number does not contain any original papers relating to chemistry, but we call attention to—

Continuation of Lectures on Animal Heat.—Dr. C. Bernard.—Illustrated with woodcuts.

April 6, 1872.

This number does not contain any original papers relating to chemistry, but we call attention to the following memoirs:—

Histology of the Medulla Spinalis, and its Functions as Organ of Transmission and as Centrum of Innervation.—Dr. Lereboulet.—Illustrated with woodcuts.

Lectures on Animal Heat.—Dr. C. Bernard.

Exploration of the Baltic Sea.—Dr. Moebius.

The American Journal of Science and Arts, March, 1872.

This number does not contain any original papers relating to chemistry.

MEETINGS FOR THE WEEK.

MONDAY, April 22nd.—Medical, 8.
—— Royal Geographical, 8.30.
—— London Institution, 4. Mr. E. J. Hopkins, "On Music."
—— Philosophical, 6. Anniversary.
TUESDAY, 23rd.—Civil Engineers, 8.
—— Royal Institution, 3. Dr. W. A. Guy, F.R.S., "On Statistics, Social Science, and Political Economy."
WEDNESDAY, 24th.—Society of Arts, 8.
—— Geological, 8.
THURSDAY, 25th.—Royal, 8.30.
—— Royal Society Club, 6.
—— Royal Institution, 3. Dr. Tyndall, LL.D., F.R.S., "On Heat and Light."
—— London Institution, 7.30. Mr. R. Liebreich, "On Turner and Mulready."
FRIDAY, 26th.—Royal Institution, 9. Prof. Blackie, F.R.S.E., "On the Genius and Character of the Modern Greek Language."
—— Quekett Microscopical Club, 8.
SATURDAY, 27th.—Royal Institution, 3. R. A. Proctor, Esq., B.A "On Star-Depths."

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THE CHEMICAL NEWS.

Vol. XXV. No. 648.

THE ACTION OF OXYGEN ON COPPER NITRATE IN A STATE OF TENSION.*

By J. H. GLADSTONE, Ph.D., F.R.S., and ALFRED TRIBE, F.C.S.

In our experiments on the action between copper and nitrate of silver in solution, we frequently noticed that the tips of the silver crystals became red, as though coated with a thin layer of metallic copper.

This apparent deposition of a positive on a more negative metal of course raised our curiosity, and led us to look closely into the circumstances under which it occurred. We found that it took place only when the nitrate of silver was exhausted, and only on those silver crystals which remained in metallic connection with the copper. We found too that the cupreous coating formed most readily where air had the freest access, and in fact that it would not form at all in vessels from which oxygen was excluded, nor on those white crystals which were far below the surface of the liquid, though they might be in immediate contact with the copper plate. When an inverted jar was filled with nitrate of copper solution, and silver crystals resting on branches of copper, and the liquid was displaced by oxygen gas, it was found that the tips of the crystals became red, and the solution gradually filled the jar again by the absorption of the gas. In the same way the oxygen was absorbed from air, or from its mixtures with hydrogen or carbonic anhydride.

This action was further studied by employing plates of the two metals instead of copper covered with silver crystals. When the two plates, connected by a wire, were partially immersed in an ordinary aqueous solution of copper nitrate, it was found that a slight yellowish deposit made its appearance speedily all over the silver plate, and went on increasing for a day or two, while at the air-line there was a thicker deposit, which gradually grew and extended itself a little below the surface. This deposit changed from yellowish to red, and under the microscope presented a distinctly crystalline appearance.

Thinking that this slight crust all over the silver plate was due to air dissolved in the solution itself, we took advantage of the reaction to prepare copper nitrate absolutely free from dissolved oxygen. An ordinary solution of the salt mixed with some silver nitrate was placed in a narrow cylinder, with a long piece of copper-foil arranged somewhat spirally, so as to retain the deposited silver on its surface, and allowed to rest for twenty-four hours. The solution thus obtained was exposed to the action of the conjoined copper and silver plates; but even after some hours there was no dimming of the lustre of the silver plate, except at the air-line, which was sharply defined. The same solution, shaken for some time in the air, produced a yellowish deposit on the white metal in three minutes.

The colour and general appearance of this crust, together with its formation only where oxygen can be absorbed, showed that it was not metallic copper, but the suboxide. This was further proved by the action of dilute sulphuric acid, which resolves it at once into red metallic copper and copper sulphate. There is also another curious reaction, which can only be properly observed under a microscope. When treated with a solution of silver nitrate, this cupreous deposit does not give the ordinary crystals of the white metal; in fact, it is only slowly acted upon: but presently there shoot forth thin threads of silver, which run through the liquid, often twisting at sharp angles, while the yellowish crystals change to black. This also was found to be a property of the suboxide of copper.

This deposition of oxide on the silver is accompanied by a corresponding solution of copper from the other plate. Thus in an experiment made with nitrate of copper solution that had been exposed to air, and which was allowed to continue for four days, there was found—

Gain of silver plate, 0·016 grm.
Loss of copper plate, 0·015 grm.

The copper necessary for the production of 0·016 grm. of suboxide would be a little above 0·014 grm.

The wire connecting the two plates in this experiment is capable of deflecting a galvanometer. The current takes place from copper to silver, that is, in the same direction as if the copper had been dissolved by an acid, and hydrogen evolved on the silver plate.

If the two plates have their sides parallel, the suboxide is deposited not merely on that side of the silver plate which faces the copper, but after about a minute on the other side also, showing that in this, as in other cases, the lines of force curve round.

It became interesting to consider what started this electric current. The original observations convinced us that it was not due to the action of oxygen on the copper; but, to make the matter more certain, bright copper and silver plates in conjunction were immersed, the copper in a pure, *i.e.* deoxygenised solution of nitrate of copper, the silver in an oxygenised solution: the two liquids communicated through the diaphragm of a divided cell. In half an hour the silver plate was covered with a reddish film, while not a trace of tarnish was perceptible on the copper. On cleaning the plates, and reversing their position, the copper was oxidised, while the silver remained free from cupreous deposit. We believe, therefore, that, through the simultaneous action of the two metals, the dissolved salt is put into such a state of tension that oxygen brings about a chemical change which otherwise would be impossible, and that this change is initiated in close proximity to the more negative metal.

Though we have examined only this particular reaction, we have satisfied ourselves that it is not an isolated fact. Each of the elements concerned may be replaced by others: thus, the sulphate may be substituted for the nitrate of copper, or platinum may be used instead of silver; chlorine may take the place of oxygen, with the production of the subchloride instead of the suboxide; and zinc may be employed as the positive metal, with zinc chloride as the salt in solution, in which case copper may be taken as the negative metal, and on its surface will form a deposit of oxide of zinc.

* A Paper read before the Royal Society.

CONTRIBUTIONS TO THE HISTORY OF THE OPIUM ALKALOIDS.*

By C. R. A. WRIGHT, D.Sc.,
Lecturer on Chemistry in St. Mary's Hospital Medical School.

(Concluded from p. 187).

III. *Action of Hydriodic Acid and Phosphorus on the Polymerides of Codeia.*

(*a*). *Dicodeia.*—When pure dicodeia is dissolved in a large excess of strong hydriodic acid (55 per cent HI) and heated, together with a piece of phosphorus, to ebullition until the boiling-point rises to 120°, methyl iodide is given off and a considerable quantity of phosphoric acid formed. The product, filtered through asbestos and precipitated with water, yields snow-white flakes that become yellow by exposure to air, and melt to a colourless oil at

* A Paper read before the Royal Society.

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100° when moist, although they do not fuse at that temperature when thoroughly dried. Dried at 100°,

0·3155 grm. gave 0·5620 CO_2 and 0·1460 H_2O.
0·1895 „ 0·1190 AgI.

		Calculated.		Found.
C_{136}	.. .. ..	1632	48·45	48·58
H_{161}	.. .. ..	161	4·78	5·14
I_9	.. .. ..	1143	33·94	33·92
N_8	.. .. ..	112	3·33	
O_{20}	.. .. ..	320	9·50	
$C_{136}H_{153}IN_8O_{20},8HI$		3368	100·00	

Hence this substance is formed by the reaction—

$$2C_{72}H_{84}N_4O_{12},4HI+20HI=$$
$$=I_8+4H_2O+8CH_3I+C_{136}H_{153}IN_8O_{20},8HI.$$

The physical properties of this substance are almost identical with those of the bodies of analogous constitution (containing C_{136}) formerly obtained from both codeia and morphia; carbonate of sodium throws down a precipitate almost insoluble in ether, showing that polymerisation to the tetra-series has taken place; agitated with a large bulk of ether, this precipitate furnishes an extract, which, on agitation with dilute nitric acid and boiling with $AgNO_3$ and NO_3H of the nitrate thus obtained, yields a precipitate of AgI, showing that iodine is contained in the precipitated base. The substance itself boiled with, $AgNO_3$ and HNO_3, produces a deep orange-coloured liquid, intermediate in tint between the blood-red produced by the derivatives of polymerised $C_{17}H_{19}NO_3$, and the deep yellow by those of polymerised $C_{17}H_{21}NO_3$, a result confirmatory to some extent of the formula deduced from the analysis, this being capable of representation as—

$$8(C_{17}H_{20}NO_3)9+9HI-4H_2O.$$

From this it appears pretty evident that the formulæ hitherto attributed to the tetra bases (containing $C_{68}-C_{72}$) are only half the true ones, which contain $C_{136}-C_{144}$.

(*b*). *Tetracodeia.*—On treating tetracodeia in the same way and continuing the ebullition until the temperature reaches 130°, a brown syrupy liquid is finally obtained, which yields, on filtration through asbestos and precipitation with water, a yellow brittle tar not fusible at 100° when quite dry; methyl-iodide is produced in quantity during the action, but only traces of phosphoric acid, and this probably by atmospheric oxidation. Dried at 100° the tar gave these numbers:—

0·3660 grm. gave 0·621 CO_2 and 0·149 H_2O.
0·5520 „ 0·363 AgI.

		Calculated.		Found.
C_{136}	.. ..	1632	46·31	46·27
H_{158}	.. ..	158	4·48	4·53
I_{10}	.. ..	1270	36·04	35·54
N_8	.. ..	112	3·18	
O_{22}	.. ..	352	9·99	
$C_{136}H_{150}I_2N_8O_{22},8HI$		3524	100·00	

Hence this substance is formed by the reaction—

$$C_{144}H_{168}N_8O_{24},8HI+10HI=$$
$$=8CH_3I+2H_2O+C_{136}H_{150}I_2N_8O_{22},8HI.$$

NO_3H and $AgNO_3$ give a blood-red colouration with this product, showing, as the analytical numbers indicate, that it is derived from polymerised $C_{17}H_{19}NO_3$, and not from polymerised $C_{17}H_{20}NO_3$, or $C_{17}H_{21}NO_3$.

The foregoing results show that the methyl group in codeia is unaltered during the polymerisation to dicodeia and to tetracodeia, and furnishes another proof of the conclusion come to in Part IV., § 2, that the addition of H_2 for C_{17}, when HI and P act on morphia or codeia, takes place *before*, and not after, the final polymerisation; even polymerisation to dicodeia could not precede this addition of H_2, as the product obtained from that polymeride has only H added on for C_{17}.

The following formulæ show clearly the difference in the action of hydriodic acid and phosphorus on codeia and its polymerides.

Alkaloid.	Temperature.	Formula of Product.
Codeia..	100°	$8(C_{17}H_{19}NO_3+H_2)+12HI$.
„	110°–115°	$8(C_{17}H_{19}NO_3+H_2)+12HI-4H_2O$.
„	up to 130°	$8(C_{17}H_{19}NO_3+H_2-O)+12HI-4H_2O$.
Dicodeia	up to 120°	$8(C_{17}H_{19}NO_3+H)+9HI-4H_2O$.
Tetracodeia.. ..	up to 130°	$8(C_{17}H_{19}NO_3)+10HI-2H_2O$.

From which it is clear that dicodeia is intermediate between tetracodeia and ordinary codeia. From the fact that 4HI for $8(C_{17})$ are added on in the case of the first product *before* the elimination of $4H_2O$, as in the second substance in the list, it may be inferred that the action is not a true substitution of iodine for hydroxyl; analogous facts have been observed in the chlorinated substances obtained by the action of HCl on codeia and morphia, the first action being apparently a direct *addition* of the elements of HCl, the subtraction of the elements of H_2O taking place at a later stage.

IV. *Action of Sulphuric Acid on Codeia and its Polymerides.*

The results detailed in the previous sections show that the action of sulphuric acid on codeia is to polymerise it, with the formation of di-, tri-, and tetracodeia, the substances obtained by Armstrong and by Anderson by this means being identical with the first and last of these bases; it appears probable that tetracodeia may be formed by the further polymerisation of dicodeia, whereas it would seem as though tricodeia were not likely to be obtained from dicodeia; on the other hand, it is possible that tetracodeia is directly produced from codeia, and that it could not be formed from dicodeia. To settle this point, pure dicodeia was heated to very gentle ebullition with sulphuric acid diluted with its own bulk of water for five hours, the operation being conducted in a long-necked flask so that no appreciable concentration by evaporation took place. At the end of this time the dicodeia was wholly converted into a base, of which ether dissolved only traces; hence no tricodeia was formed. After precipitation by Na_2CO_3 and drying, the free base was dissolved in alcohol and fractionally precipitated by ether. If the alcoholic solution be nearly free from water, the ether throws down solid amorphous flakes; but if 10 or more per cent of water be present, the ether precipitate is a tarry fluid containing water, alcohol, and the base. Flakes of tetracodeia were thus obtained identical in all respects with that obtained by the action of phosphoric acid; a trace of some product of the further action of sulphuric acid appeared to be present, however, as the free base turned slightly green on drying, without, however, absorbing so much oxygen as to make any appreciable difference in its composition. Dried at 100°, 0·221 grm. gave 0·583 CO_2 and 0·142 H_2O.

		Calculated.		Found.
C_{144}	.. .. ..	1728	72·24	71·94
H_{168}	.. .. ..	168	7·02	7·14
N_8	.. .. ..	112	4·68	
O_{24}	.. .. ..	384	16·06	
$C_{144}H_{168}N_8O_{24}$		2392	100·00	

If the action of sulphuric acid be pushed further than this point, a smell of SO_2 is perceptible, and the product obtained rapidly oxidises on precipitation by Na_2CO_3 and exposure to air. Nothing fit for analysis was obtained from the product, which probably is formed by the dehydration, oxidation, and possibly de-methylisation of tetracodeia.

V. *On the Physiological Action of the foregoing Polymerides.* By Reginald Stocker, *M.B., Pathologist in St. Mary's Hospital Medical School.*

An aqueous solution of the hydrochlorate of codeia and its polymerides was in each case employed, being subcu-

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neously injected into adult cats (a dog being also employed in a few experiments), quantities equivalent to grm. of the anhydrous salt being used in each experiment. Four cats were employed, several trials being made with each animal, and three or four days being allowed to intervene between each experiment, so that the effects of one dose had entirely passed away and the animal entirely recovered before the administration of another dose. The main results observed were as follow:—

Codeia.—Four experiments. In each instance dilated pupils; cerebral congestion (determined by ophthalmoscopic examination), and much increased reflex excitability (epileptic convulsions in one case); salivation and purging in two cases; vomiting not produced in any case.

Dicodeia.—Two experiments. In each instance vomiting; fundus of eye not congested; pupil dilated in one case.

Another experiment with a dog (full-grown she-terrier) produced salivation and purging without vomiting; no cerebral congestion.

Tricodeia.—Three experiments. In each case salivation (profuse) and dilated pupils; no cerebral congestion; in one case slight excitement; in the others purging and depression; vomiting produced in one of these two latter instances, micturation in the other.

Tetracodeia.—Four experiments. In each case profuse salivation, micturation, and depression; dilated pupils in three instances, and lachrymation in two; in one case vomiting and purging; in another increased reflex excitability with an occasional convulsion (cat was weak and not in good condition); slight hypnotism in two cases.

In two experiments with the dog salivation and depression only were produced.

From these results it would appear that codeia produces cerebral congestion and increased reflex excitability without vomiting; whilst di- and tetracodeia produce profuse salivation and some depression, with vomiting in several instances; no evidence of cerebral congestion and but little of increased reflex excitability being noticeable.

Reagent &c.	Codeia.	Dicodeia.	Tricodeia.	Tetracodeia.
Alcohol.	Soluble.	Soluble.	Soluble.	Soluble.
Ether.	Soluble.	Soluble.	Soluble.	Insoluble.
Character of base.	Crystalline, stable in the air.	Amorphous, stable in the air.	Amorphous. Very slowly oxidises while moist.	Amorphous. Very slowly oxidises while most.
Character of hydrochlorate.	Crystallises with $2H_2O$ for C_{18}; not lost at 100°.	Crystallises with $3H_2O$ for C_{18}; lost at 100°, and partially at lower temperatures.	Non-crystalline, extremely deliquescent.	Non-crystalline, deliquescent.
Ferric chloride.	Nil.	Nil when pure.	No colour at first, reddish-purple on standing.	Reddish-purple colour immediately.
Nitric acid.	Light orange.	Light orange.	Blood-red.	Blood-red.
Potassium dichromate and sulphuric acid.	Nil.	Nil.	Evanescent red.	Evanescent red.
Sodium carbonate and solution of hydrochlorate.	No immediate precipitate, crystals on standing.	Instantaneous amorphous precipitate but little soluble in excess.	Same as dicodeia.	Same as dicodeia.
Caustic potash and solution of hydrochlorate.	Oily precipitate if concentrated, becoming crystalline on standing. Not markedly soluble in excess.	Oily precipitate if concentrated, not becoming crystalline; more dilute solutions give a white amorphous precipitate soluble in large excess.	Same as dicodeia.	Same as dicodeia.
Action of hydrochloric acid not pushed to extreme.	Product contains Cl for C_{36}; further action contains Cl_2 for for C_{36}.	Product contains Cl for C_{72}.	H_2O removed for C_{18}; no basic Cl contained in product.	Nil.
Action of hydriodic acid in conjunction with phosphorus, not pushed to extreme.	Polymerises with elimination of CH_3 for C_{18}, forming bases derived from $(C_{17}H_{21}NO_3)8$, H_2 being added on for C_{17} in product.	Polymerises with elimination of CH_3 for C_{18}, forming bases derived from $(C_{17}H_{20}NO_3)8$, H being added on for C_{17} in product.	—	CH_3 eliminated for C_{18}; product derived from $(C_{17}H_{19}NO_3)8$, *no* H being added on, but simply I substituted for OH.
Action of sulphuric acid, not pushed to extreme.	Polymerises, forming successively di-, tri-, and tetracodeia.	Polymerises, forming tetracodeia.	—	Nil. Further action probably dehydrates and oxidises.
Formula inferred from above properties and reactions.	$C_{36}H_{42}N_2O_6$.	$C_{72}H_{84}N_4O_{12}$.	$C_{108}H_{126}N_6O_{18}$.	$C_{144}H_{168}N_8O_{24}$.
Physiological action of 0·1 grm. of anhydrous hydrochlorate subcutaneously injected into adult cats.	Extreme hypersensitiveness and cerebral congestion, dilatation of pupils; no diarrhœa; no vomiting in any instance.	No hypersensitiveness nor cerebral congestion; dilatation of pupils; vomiting in every instance. With a dog profuse diarrhœa without vomiting.	Hypersensitiveness scarcely marked; vomiting in some instances, in others salivation and defæcation.	No hypersensitiveness; vomiting, salivation, or diarrhœa in every case; great depression. With a dog profuse salivation and depression

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VI. *Conclusions.*

The foregoing results suggest the probability of other bases being capable of forming similar polymerides. In anticipation of this result experiments are in progress with morphia.

Hesse has shown* that by the action of HCl on thebaine there are produced two isomerides of that base, one forming crystalline salts, one amorphous salts; not improbably these are respectively dithebaine and tetrathebaine.

Matthiessen and Foster have shown† that cotarnine occurs in crystals of the formulæ—

$$C_{12}H_{13}NO_3+\tfrac{1}{2}H_2O \text{ and } C_{12}H_{13}NO_3+H_2O;$$

and the writer's observations indicate that the former substance is more stable than the latter, which rapidly become more or less coloured; not improbably these two forms are polymerides, the first being $C_{24}H_{26}N_2O_6+H_2O$, the second $(C_{12}H_{13}NO_3)_nH_2O$. Opianic acid‡, on heating, furnishes an anhydride of formula $C_{40}H_{38}O_{19}$; this tends to show that the formula of this acid is not less than—

$$C_{20}H_{20}O_{10};$$

not impossibly, therefore, the formula of narcotine may be double that usually ascribed to it; from their physical properties it is not improbable that the dimethylnornarcotine, methylnornarcotine, and nornarcotine of Matthiessen may be derivatives not of ordinary narcotine, but of its polymerides.

The different modifications of the cinchona alkaloids are not impossibly polymerides of one another.

The subjoined Table exhibits the principal differences between codeia and the polymerides above described.

* *Ann. der Chem. und Pharm.*, vol. clxiii. p. 47.
† *Proc. Roy. Soc.*, vol. xvii., p. 342, § V.
‡ *Ibid.*, p. 341, § III., Matthiessen and Wright.

THE EVIDENCE OF EXPERTS.

In Philadelphia we have had recently the spectacle of a professed chemist and toxicologist making an examination of the body of a man supposed to be poisoned, and carrying his investigations far enough to convince himself of the presence of antimony, and forgetting there was a jury and a public to be convinced as well, appearing on the witness stand without a particle of proof that he found it, except his bare assertion. The prisoner in this case was acquitted, on the evidence of other experts called for the defence.

In Albany, some twenty years since, a man was hung for poisoning his wife by aconite, on the evidence of a professed chemist, who swore he obtained aconite by a process that never detected it before and never detected it since, and this, notwithstanding that other chemists swore that the process described would, so far from detecting, absolutely prevent the detection of aconite, were it present.

In a recent trade-mark suit, relating to the manufacture of mustard, Dr. Ogden Doremus, of this city, swore that mustard seeds contained over 11 per cent of starch. To prove it, he used a solution of iodine upon mustard placed on filtering paper, which paper gave, when tested, the characteristic reaction of iodine with starch when no mustard was present. The error in the experiment was pointed out by Professors Seely and Chandler. Dr. Doremus was aided by Dr. Austin Flint, who tried to confirm by the use of a microscope what Dr. Doremus tried to prove by the iodine test. Dr. Flint swore that he could see the granules of starch by the use of a high power. Professors Seely and Chandler could not see any such granules, but they did see what they thought might have been fragments of the exterior envelopes of the seeds. Dr. Doremus has, in a letter since published, affirmed the presence of starch in mustard seed (he says nothing of the percentage), and attempted to prove it by a test which would give the same results with cellulose as with starch.

Now, in view of such facts as these, is it any wonder that the public is beginning to mistrust the value of this kind of evidence? Such a mistrust is based upon good grounds enough. As now presented to juries, the testimony of the both competent and imcompetent witnesses only serves to muddle their intellects, and to complicate rather than make plain the facts.

If it be necessary to give juries authoritative instruction on points of law, how can it be less necessary that they should be similarly instructed in matters involving scientific knowledge. To bring before them A, who swears to one thing and swears to the truth, and then bring B, the charlatan, who looks and talks twice as wisely as A, and denies under oath all that A has asserted, is not to instruct, but to mystify them. When Counseller X tells the jury in his address that something is law which is not law, the Court quietly corrects the assertion in his charge, and the correction has the weight of authority. The jury believe the judge and discredit Counsellor X. But when Charlatan B tells them something is science that is not science, the true, yet modest A's assertions are no more authoritative to decide the question than B's. The jury must decide, or rather make a guess, as to what is right or wrong; and the average juryman is rather more likely to guess wrong than right in matters of science.

Now there is a plain, simple, and practical remedy for this state of things. In all cases where there are points of law to be decided, there is an arbiter on the bench to perform that office. There should be an equally authoritative tribunal to decide on scientific points, a separate jury of experts, if may be, constituting, for the time, a scientific court, whose charge to the jury should be as authoritative as that of the judge. Would it not be refreshing to hear such a witness as the one mentioned above, who swore to finding aconite, disposed of in the following fashion:—"It is my duty, gentlemen of the jury, as foreman of the scientific jury in this case, to instruct you that aconite cannot be detected by the process described in the testimony of the witness. However much he may be convinced that he did so, it is contrary to known laws of chemistry to suppose that he so obtained it. You are, therefore, to dismiss from your minds the possibility of such a result in your deliberations upon this case." Or perhaps this:

"The process sworn to by A will obtain arsenic from the stomach of a person poisoned by that substance. The process sworn to by B will not obtain it. A says that by his process he found no arsenic. B says he found it in a process by which he could not have found it. It remains for you to judge whether, if by an accurate method arsenic could not be found, the testimony of one who swears he found it by an impossible process proves its presence."

Let such a course be pursued, and we soon should have somewhat less of *pseudo* science on the witness stand, and true scientific testimony would become of real value.—*Scientific American.*

ON THE PRESENCE OF IODATE OF CALCIUM IN SEA-WATER.

By E. SONSTADT.

Having had occasion to study the conditions under which iodides may be oxidised into iodates in the presence of a free or carbonated alkaline or earthy base, my experiments showed that an iodide could not permanently exist in solution under such conditions, and with free exposure to air, without undergoing oxidation into iodate. Hence it was inferred that whatever iodine sea-water contains must be in the state of iodate, since the conditions present in sea-water come within the range of the conditions experimentally ascertained. It was further inferred from

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the results of experiments made upon the iodates, and especially upon iodate of calcium, that iodine must always be set free in sea-water wherever there is putrescent organic matter; and that, while this is being oxidised at the expense of the oxygen in the iodate, the freed iodine slowly re-forms iodate by the decomposition of water conjointly with that of carbonate of calcium. It was ascertained by direct experiment that an iodate can be formed in a liquid in which hydrogen is nascent.

My experiments upon sea-water have been made upon three specimens, drawn respectively from near the Light-Ship on the Bahama bank, about seven miles from Ramsey, Isle of Man; from the bay opposite the small river passing through Ramsey, and taken at about half a mile from the pier; and from the shore, about half-way between Ramsey and Manghold Head. For the first-named specimen I am indebted to the kindness of Captain Temple, of the Light-Ship. This specimen, of sp. gr. 1·02706 at 7°, contained no sensible proportion of free iodine, although I have had it a long while and it has been kept in a wooden cask. The specimen from the Bay had sp. gr. 1·0235 at 11°. It was not perfectly limpid, and, upon shaking up with carbonic disulphide, gave the iodine colouration. The water taken near the shore had sp. gr. 1·02636 at 11°, and when fresh, gave no iodine reaction when shaken up with carbonic disulphide, and contained all its appreciable iodine, as did the water from the Light-Ship, in the state of iodate. But after a few days its condition changed; it contained free iodine, and retained scarcely a trace of iodate.

The experiments now to be described relate to the sea-water taken near the Light-Ship, and to the specimen of water from near the shore in its fresh state. Sulphuretted hydrogen passed through such water causes considerable opalescence from deposited sulphur (much more than can be ascribed to the nitrates present), especially after warming, and an iodide is then contained in the water. Many other reducing agents may be used, and especially ferrous sulphate or sulphite of sodium. The reaction with ferrous sulphate is remarkable. If a minute crystal of this salt is dropped upon the surface of the sea-water so that it may float, and the test-tube or beaker is held in a suitable light, white clouds of ferrous iodate may be seen to form in the train of the solution descending from the crystal. If too large a crystal is taken, the effect is marred or lost, as a very slight excess of ferrous salt makes a clear solution. A precisely similar reaction may be obtained between the ferrous salt and an excessively dilute solution of iodate of calcium. The colour of the precipitate soon changes to brown. To obtain an iodine reaction from the sea-water, it is sufficient to add a minute proportion of ferrous sulphate, some dilute sulphuric acid, and a drop or two of carbonic disulphide. After a while, and from a quantity of water of about 50 to 100 c.c., a recognisable iodine colouration is obtained. If too much ferrous salt is used, the reaction is very evanescent; but it may be restored, though not quite perfectly, by cautious addition of a few drops of dilute chlorine water. Sulphurous acid, not in excess, may be used in place of ferrous sulphate in this experiment. If the sea-water is in good condition, it may be concentrated without loss of iodine or decomposition of the iodate of calcium, which, however, separates with the other calcium salts in great part, so that beyond a certain point the proportion of iodate in the liquid does not increase with further concentration. The quantitative estimation of the iodine in sea-water is difficult, owing to the exceedingly small proportion in which it is present, and the number of elements of which the action must be taken into account. It is easy to transform the iodate into iodide; but, to do this, and evaporate to dryness and exhaust with alcohol, is useless as a quantitative method, owing to the more or less sparingly soluble salts which iodine forms with silver, rubidium, and cæsium —all recognised as being present in sea-water. Thallium, also, forms an iodide belonging to the same class; and, although I have not seen this mentioned as contained in sea-water, it must be there, since I have found it in the ash of sea-weed. Even iodide of sodium is but sparingly soluble in alcohol. The method of exhaustion by alcohol is therefore not available. With the view to overcome this difficulty, I experimented upon the relative solubilities of the halogen salts of silver in pure, strong hydrochloric acid. It was found that pure iodide of silver requires 150,000 parts of *hot* hydrochloric acid to dissolve it, and that from this solution it crystallises on cooling. The solubility of chloride of silver appears to vary according to the condition it is in; but in no case was it found to require more than about 2000 parts of cold hydrochloric acid for solution; and, in one instance, 1 part of the chloride was obtained in solution in 342 parts of *hot* acid, the solution crystallising on cooling. The solubility of bromide of silver is less than that of the chloride; but, relatively to the iodide, the bromide and chloride of silver may be classed together. I found, further, that while the addition of sulphurous acid to hydrochloric acid greatly increases its action upon chloride and bromide of silver, it has little, if any, effect in increasing the solubility of iodide of silver. The addition of nitric acid, or, what amounts to the same, of chlorine, enables the acid to dissolve the iodide pretty freely. Ferrous sulphate added to the acid produces a like result.

The application of the facts above stated to the quantitative estimation of the iodine in sea-water I reserve for a future communication, confining myself here to a statement of the manner in which I have applied them to the qualitative proof of the presence of iodine, by way of confirmation of the results obtained by the other methods indicated. One or two hundred cubic centimetres of the water to be examined are shaken up with a few drops of solution of slightly alkaline sulphite of sodium, prepared from pure sulphurous acid, and hydrate of sodium made from the metal. After some time, two or three cubic centimetres of saturated solution of acetate of silver are added, and then about a fourth of the volume of the liquid of strong hydrochloric acid free from chlorine. The liquid is left at rest for a few hours, then filtered, the filter washed with dilute hydrochloric acid, and lastly with a little water. The filter is then moistened with a strong solution of pure hydrate of sodium, and heated in a covered crucible to low redness for a few minutes. After cooling, water is added, the solution filtered, and the filtrate, strongly acidulated with dilute sulphuric acid, is shaken up with carbonic disulphide and sufficient very dilute chlorine water to develop the sodium reaction. By proceeding in this way, a fine colouration is obtained from about 200 c.c. of the water.

A soluble sulphide or sulphuretted hydrogen cannot exist in presence of an iodate. But sea-water overcharged with effete matter, as before the mouth of a river conveying sewage from a town, such as was the specimen of water taken opposite the mouth of the river at Ramsey, does, on prolonged boiling, give off sulphuretted hydrogen, although it contains no trace of a sulphide before heating, as was proved, in the case referred to, by the total absence of colouration on addition of acetate of lead to the water.

So far as my experiments go, I find that it is only *putrescible* organic matter that is decomposed by and decomposes iodate of calcium. My experiments also indicate that this substance (the iodate) possesses, in a high degree, the power of preventing fungoid growths in very putrescible liquids. The alkaline iodates behave in this, and in other respects, differently to the iodate of calcium.

My principal object in conducting the investigation, of which this note gives a preliminary account, is to subject to rigorous experimental tests a theory respecting the function of the iodate of calcium in the sea; to which, notwithstanding the extremely small proportion in which it exists, I attribute the property of maintaining, owing to its condition of unstable equilibrium, and thereby its action on putrescible matter, not only the salubrity of the sea, and, through the medium of the atmosphere, of the land

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also; but also that of furnishing the ammonia required by the *Fuci*, by the presentation of nascent hydrogen derived from the decomposition of water, to the nitrogen liberated during the oxidation of dead organic matter. If I am right in my view, the activity of this agent is necessarily exactly in proportion to the need for its activity—being adjusted thereby—the work being done at the expense of the decomposition of water.

I trust before long to communicate the details and results of further experiments, especially with reference to the quantitative determination of the iodine in sea-water; and to the properties of iodate of calcium, and the relation of these properties to the place it occupies in Nature's grand system of hygiene.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, April 18th, 1872.

DR. FRANKLAND, F.R.S., President, in the Chair.

THE PRESIDENT announced from the chair the presence of Professor Himly, of Kiel, and of Professor Eschenburg, as visitors.

After the minutes of the preceding meeting had been read and confirmed, Messrs. R. W. Atkinson, George Attwood, and William H. Walbourn were formally admitted Fellows of the Society.

The donations were then announced, and the following names read for the first time:—Messrs. C. H. W. Biggs, John Grove Johnson, Joseph Arderne Ormered, B.A., and Ernest Henry Jacob, B.A. For the third time—Messrs. Thomas Tyrer, Frederick William Fison, B.A., George Blundell Longstaff, B.A., John Robins, Thomas Robertson Ogilvie, Mark Finch, and Arthur John Dickinson; these gentlemen were then ballotted for and duly elected Fellows of the Society.

The Secretary then read a paper "*On Benzyl Isocyanate and Cyanurate*," by E. A. LETTS, in which the author, after noticing the ethylic and methylic isocyanates and isocyanurates discovered by Wurtz, the corresponding phenyl compounds, and the so-called phenyl isodicyanate, remarks that in the toluol group eight possible compounds may exist, of which only three have as yet been obtained, viz., toluyl isocyanate and isocyanurate by Hofmann, and benzyl cyanurate by Canizzaro. On distilling a mixture of silver cyanate and benzyl chloride in a paraffin-bath, benzyl isocyanate comes over mixed with benzyl chloride, and ultimately, on raising the temperature, benzyl cyanurate. The isocyanate—

$$C_8H_7NO = \left.\begin{matrix} CO \\ C_6H_5CH_2 \end{matrix}\right\} N,$$

is a colourless liquid having a pungent odour, which, although it cannot itself be obtained pure enough for analysis, yields several derivatives capable of purification. *Monobenzyl urea*, $C_8H_{10}N_2O$, obtained by the action of alcoholic ammonia on the impure benzyl isocyanate, crystallises in long white needles, which are almost insoluble in cold water, but readily soluble in alcohol; it melts at 144°. *Dibenzyl urea*—

$$\left.\begin{matrix} CO'' \\ (C_7H_7)_2 \\ H_2 \end{matrix}\right\} N_2,$$

formed by heating the isocyanate with water, melts at 167°, and closely resembles the monobenzyl compound in appearance and properties. Phenyl-benzyl urea, $C_{14}H_{14}N_2O$, was also prepared. The benzyl isocyanurate—

$$\left.\begin{matrix} (CO'')_3 \\ (C_7H_7)_3 \end{matrix}\right\} N_3,$$

mentioned above, crystallises from its solution in hot alcohol in long slender needles, which melt at 157°, and when fused with potassium hydrate, yield benzylamine, $C_7H_7.H_2N$. From the close resemblance in properties between the isocyanurate just described, and the benzyl cyanurate discovered by Canizzaro, the author thinks it probable that they may be identical.

A second paper by the same author, "*On a Compound of Sodium and Glycerine*," was then read. Since glycerine is a triatomic alcohol, three sodium compounds of this body should exist, in which 1, 2, and 3 of the hydrogen respectively are replaced by the metal. By the action of sodium amalgam on glycerine and subsequent treatment with alcohol, or better, by dissolving sodium in alcohol and adding glycerine, a solid compound is obtained, insoluble in alcohol and exceedingly deliquescent. When dried between filter-paper, it has the composition $C_3H_5.NaO.HO.HO + C_2H_5.HO$, but loses the combined alcohol when heated to 100° in a current of hydrogen, leaving mono-sodium glycerine, $C_3H_7NaO_3$, as a white amorphous powder. The latter is decomposed by water into glycerine and sodium hydrate, and, when heated, yields acrolein.

DR. HOFMANN said that the production of benzyl isocyanate formed a very interesting and striking lecture experiment. It was very important to show the different position of the chlorine in the isomeric chlorine substitution compounds of the aromatic series: for instance, two isomerides were obtained from toluol by the action of chlorine; that in the cold being chloro-toluol, in which the chlorine entered into the benzene; whilst at a high temperature, benzyl chloride was formed, in which the chlorine was in the methyl. If small quantities of each of these chlorides were taken, and dry silver cyanate added to them, the toluol chloride was quite unacted on, whilst the benzyl chloride was decomposed with explosive violence; and even if they were not fortunate enough to see the experiment, they would be able to smell it, the pungent isocyanate vapour producing powerful lachrymation. In answer to a remark of the President, Dr. Hofmann said he had some new and interesting compounds to exhibit, which he would like to illustrate by a few experiments, but as these would leave a bad odour behind them, he must ask to be permitted to defer them until the close of the sitting.

"*On the Determination of Carbonic Acid in Sea-Water*," by Professor HIMLY. The author, who delivered his address in German, after noticing the difficulties which beset the determination of carbonic acid in sea-water—Jacobsen having shown that the whole of the gas present is not given off by boiling either *in vacuo* or under the ordinary pressure at 100°, even when a current of air is passed through the liquid—said, however, that the whole of the carbonic acid could be readily estimated by adding baryta-water or barium nitrate, ammonium nitrate, and ammonia to a measured quantity of the sea-water, thus obtaining the whole of the carbonic acid in the precipitate. After the supernatant liquid had been removed, the carbonic acid might be estimated in the precipitate. In order to collect sea-water for the determination of the carbonic acid at great depths, and consequently under great pressures, it was necessary to sink a cylinder open at both ends to the place where the water was to be collected, and then to securely close it there. The apparatus for that purpose, closed by valves, had been found to be very defective; but he had employed one which answered admirably, consisting of a cylinder furnished with a large stopcock at each end. When this cylinder had been sunk to the required depth, the stop-cocks were closed by powerful springs released at the proper moment by means of an electro-magnet set in action in the usual way.

THE PRESIDENT said that the problem of the determination of the carbonic acid in sea-water was at the present time of peculiar interest, as an expedition was being fitted out to sail round the world, and one of its objects was to

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collect sea-water at various depths, and either to make determinations of the gas contained in it on board ship, or to bring it home for that purpose. Dr. Carpenter deemed it of the greatest physiological importance to determine the amount of carbonic acid in the water; and since the ordinary method failed to eliminate the whole of the carbonic acid—Professor Himly having mentioned that but little of that gas is evolved until the water is evaporated to about one-half, when it comes off somewhat suddenly—its conversion into baric carbonate would allow of the determination being made in a quiet sea, or of being brought home for that purpose.

In reply to a question by the President, Professor McLEOD remarked that with fresh water he had never observed the sudden evolution of carbonic acid described. All the dissolved carbonic acid was given off *in vacuo* at 50°, although to eliminate the whole of the combined carbonic acid it was necessary to evaporate to dryness *in vacuo*. He had only made two experiments with sea-water, and those with a sample which had been collected some years previously.

Professor HIMLY said that when sea-water was distilled, the magnesium chloride present was decomposed, hydrochloric acid passing off, and the magnesium remaining behind combined with a portion of the carbonic acid. At the request of the President, he also explained the manner in which the apparatus for collecting sea-water at great depths was closed.

Two short papers by Dr. T. E. THORPE were then read by the Secretary; the first being "*On the Action of Phosphorus Pentasulphide on Tetrachloride of Carbon*," from which it would appear that the pentasulphide has no action on tetrachloride of carbon, even when heated with it to 200° for a week. The second was "*On the Degree of Solubility of Silver Chloride in Strong Nitric Acid.*" The author submitted silver chloride prepared with great care to the action of strong nitric acid, which had been purified as far as possible, and found that 100,000 parts of the acid dissolved about 2 parts of silver chloride, the presence of lower oxides of nitrogen in the acid not sensibly affecting the result. When, however, the silver chloride had become blackened by exposure to light, it was less soluble in the acid, 100,000 parts dissolving only 0·8 parts of the blackened chloride.

Mr. SPILLER said that, from an experiment he had made in which silver chloride was exposed under water to the action of light for some years, he believed it was decomposed, and that this might even proceed so far as to leave the metal; darkened silver chloride would therefore consist of unaltered silver chloride mixed with more or less metallic silver.

Dr. HOFMANN said he would like to avail himself of the opportunity he enjoyed of being once more at the Chemical Society, to exhibit to the Fellows some interesting compounds he had lately been working with. About ten years ago, he had examined the ethylic derivatives of phosphuretted hydrogen, and, in order to obtain them, had acted with phosphorus trichloride on the zinc-ethyl discovered by the President; this, however, only yielded the tertiary compound, and although he had often felt a desire to obtain the primary and secondary members of the series, his endeavours were in vain. Nearly every year since that time he had made experiments with this object, for if the lower members could be prepared we might expect to obtain from them many compounds, such as the isocyanates and mustard oils, which the tertiary, from its great stability, does not yield. A lecture experiment, however, indicated the method by which during last summer he had succeeded in preparing a considerable quantity of these lower phosphines. He was desirous of exhibiting the decomposition of phosphuretted hydrogen by the electric spark in the same manner as ammonia, but found that the gas prepared by the ordinary methods was always impure, containing as much as 60 to 80 per cent of hydrogen. The action of water on iodide of phosphonium, PH_4I, however, which can be prepared by Baeyer's method in any quantity, yielded phosphuretted hydrogen in a state of absolute purity. By placing the iodide in a small flask, and allowing water or potash solution to drop on it, any desired quantity of phosphuretted hydrogen may be obtained; and on introducing this into the eudiometer, and passing the spark current for less than five minutes, phosphorus is deposited on the sides of the tube, the two volumes of PH_3 leaving three volumes of hydrogen. This forms a magnificent lecture experiment. It will be seen that the iodide of phosphonium furnishes us the means of generating pure phosphuretted hydrogen, even under pressure, so that methylic or ethylic iodide can be conveniently submitted to its action in the same manner as, many years ago, ethylamine was prepared from ammonia by the action of ethylic iodide. A large tube was therefore partly filled with iodide of phosphonium, and zinc oxide rammed down on the top of it, so as to allow sufficient time to close the tube before the ethylic iodide, which was now introduced, could penetrate to the phosphorus compound. On agitating the tube and mixing the contents, a reaction took place with methylic iodide even at the ordinary temperature, although it was better to heat to 100°. Ethylic iodide required 120°, and higher temperatures were employed for the higher members of the series. It was found that the action of ethylic iodide on iodide of phosphonium in the presence of zinc oxide or water produced the two substances, ethyl and diethyl phosphine, which had been so long sought for without any admixture of the higher compounds. As there was but a comparatively small quantity of the substance in the first instance, considerable difficulty was anticipated in separating them, but it was found that these compounds, so to say, separated themselves. The iodide of ethyl-phosphonium, EH_3NI, has so much the character of the iodide of phosphonium, that, on allowing a stream of water to flow into the mixture, it was at once decomposed, giving off the monethyl-phosphine in a state of absolute purity, whilst the secondary compound was unacted on. After distilling off all the EH_2P, the addition of potash liberated the diethyl-phosphine, and that could likewise at once be obtained in a state of purity. Even if they had been less easily separated, the considerable quantities afterwards operated on would no doubt have ultimately enabled them to be separated, as in this research some 6 or 8 kilogrms. of iodide of phosphonium had passed through the speaker's hands. The question naturally suggested itself whether the hydriodic acid in the iodide of phosphonium could not be made to furnish the ethylic iodide for the conversion of the phosphuretted hydrogen into phosphorus bases. On treating the iodide with absolute alcohol to 100°, an action takes place, but, strange to say, only the tertiary and quarternary compounds are produced, the same as those obtained from zinc ethyl by phosphorus trichloride.

Dr. Hofmann then experimentally exhibited the formation of phosphuretted hydrogen by the action of water on iodide of phosphonium, and the decomposition of iodide of ethyl-phosphonium by water, liberating the ethyl-phosphine, EH_2N, which has the characteristic odour of the phosphorus bases. He also explained Baeyer's method of preparing iodide of phosphonium on the large scale by the action of water on iodide of phosphorus, stating that it was necessary to employ a very large excess of phosphorus, three or four times the theoretical, since much of it is converted into the amorphous state, and thereby rendered inactive.

The PRESIDENT, in thanking Dr. Hofmann, said that these interesting compounds, obtained as they were so readily in a state of absolute purity, would form starting-points for new researches, for the results of which they should anxiously look forward.

The meeting then adjourned until Thursday, the 2nd of May, when Mr. E. Riley will deliver a lecture "On the Manufacture of Iron and Steel."

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ROYAL IRISH ACADEMY.

At a meeting of this Society held on Monday, April 8th, Mr. G. J. Stoney, F.R.S., read a most valuable and interesting paper "*On the Constitution of the Outer Atmosphere of the Sun.*" The principal objects of this paper were to point out that certain theoretical speculations of the author, published on the Physical Constitution of the Sun and Stars (*Proc. Roy. Soc.*, vol. xvii., p. 1, and other journals), had been verified by spectroscopic observations of the sun during eclipse, and also to account for certain unknown lines. The constituents of the solar atmosphere will range to heights which stand in the order of the masses of their molecules. If, for example, an atmosphere of uncombined nitrogen and hydrogen, the boundary of each gas will be at a different height; where the nitrogen is no longer able to maintain itself, the molecule of hydrogen, with a velocity $\sqrt{14}$ (or nearly 4) times as great, can still spread far beyond it (the lecturer was speaking from the point of view which holds to the dynamical theory of the molecular constitution of gases), although the nitrogen will reach a greater height in consequence of the presence of the hydrogen than it could alone.

The following were some of the coronal and other lines observed, the wave-length being the number in a millimetre measure *in vacuo*:—

		Hydrogen.		Lithium.
	C	1523·47	Li_1	1490·92
	F	2056·72	Li_2	1638·29
	G	2303·44	Li_3	2010·70
	h	2437·62	Li_4	2171·98
	H	1416·00 (?)	Chromospheric	
Coronal line.	D_3	1702·80	lines of	
	Y	1880·60	hitherto un-	
	Z	2235·80	known origin.	

Calcium, chromium, manganese, iron, nickel, cobalt, copper, zinc, and barium lines are found in the photosphere, but only such atoms as sodium and magnesium could rise to coronal heights. Mr. Stoney believes the line D_3 to be a fourth hydrogen line, and that the other chromospheric lines are due to lithium.

There was also a paper read, contributed by F. Webber, "*On the Floatation of Sand on the Surface of the River Ganges.*"

ROYAL GEOLOGICAL SOCIETY OF IRELAND.

At the meeting held on Wednesday, the 10th inst., Mr. Westropp gave a "*Sketch of the Physical Geology of North-West Clare*" and Mr. Edward Hull, F.R.S., read a paper entitled "*Remarks on the Report of the Royal Commission on the Coal Resources of Great Britain and Ireland.*"

Specimens of xanthophyllite, a rare Russian mineral, were exhibited by Dr. Frazer.

NOTICES OF BOOKS.

Index of Spectra. By William Marshall Watts, D.Sc., Senior Physical Science Master in the Manchester Grammar School. With a Preface by H. E. Roscoe, B.A., Ph.D., F.R.S., Professor of Chemistry in Owen's College, Manchester. London: Henry Gillman. 1872.

All workers with the spectroscope will agree with Dr. Roscoe in the inconvenience arising from the employment of different scales in the mapping of spectra; and they will welcome Dr. Watts's endeavour to facilitate spectroscopic research by collecting all existing measurements of the spectra of the elements, and presenting them on a uniform scale of wave-lengths. Dr. Watts has adopted as the basis of his work Angström's measurements of the wave-lengths of the principal Fraünhofer lines, the most accurate obtainable. These measurements are so very exact that it is unlikely that any corrections which may be rendered necessary by new and more exact measurements will affect them, except in the decimal place. The spectral lines are calculated to the ten-millionth part of a millimetre throughout. But Dr. Watts besides has collected the numbers obtained by Fraünhofer, Ditscheiner, Van de Willigen, Bernard, Mascart, and Esselbach, as well as the mappings of most of the spectra of the elements by Huggins, Thalén, and Kirchhoff. In the case of the elements whose spectra have not been examined by Thalén, Huggins, or Kirchhoff, the most accurate results have been given, with references to the original memoirs. The numbers given from Mascart, Ketteler, and Müller were obtained by direct observation of the diffraction spectra; while Plücker's measurements for chlorine, bromine, iodine, phosphorus, sulphur, selenium, nitrogen, and oxygen have been reduced to wave-lengths by means of an interpolation-curve drawn from the lines of oxygen and nitrogen. Twenty-eight of the measurements of the spectra of the elements are checked by comparison with Dr. Gibbs's results. Chromo-lithographs of the double spectra of nitrogen, sulphur, and carbon are given. The intensities of the various lines are clearly compared; and, indeed, all has been done that will in any way assist the spectroscopist. The work will be found equally as useful with instruments of only one or two prisms as with the largest spectroscopes. We commend it to the notice of our readers.

CORRESPONDENCE.

ESTIMATION OF NITROGEN IN NITRATES.

To the Editor of the Chemical News.

Sir,—I read with much interest, Mr. John Ruffle's paper on "The Estimation of Nitrogen in Nitrates by Combustion" in the Chemical News (vol. xxv., p. 189), but was disappointed to find that, though we are informed that the estimation is conducted by a modification of the usual process, we are left entirely in the dark as to what the *modus operandi* really is.

Perhaps Mr. Ruffle will favour us with more details, which, I am certain will prove useful to chemists as yet beyond the pale.—I am, &c.,

Rowland J. Atcherley.

39, British Street, Bow, E.
April 22, 1872.

ORIGINAL RESEARCH.

To the Editor of the Chemical News.

Sir,—Permit me to offer a few remarks on the subject of the letter of your correspondent "A. T." concerning the want of recognition of original research.

A. T. very truly says that help from Universities in this matter is not looked for; for the obvious reason that the case is beyond their province. Before a man can be qualified to become a trustworthy experimentalist, a large amount of preparation and study, theoretical and practical, is indispensable; a thorough knowledge of the results obtained by previous workers is requisite, and a liberal education, not only in the particular branches of science to which he intends to devote himself, but also in other departments, is, if not absolutely necessary, at the least extremely desirable. A University can do no more than guarantee that a man has conscientiously gone through this amount of *preparatory* training; *apropos*, it may be

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doubted if the recognition obtained by passing an examination which merely requires that the candidate shall, by dint of *coach* or *cram*, manage to partially answer some of a series of questions, is of any real help in the struggle for existence.

A man who, after acquiring a thoroughly solid scientific education, devotes himself to original research, has at present for sole recompense the pleasure he experiences in his labours of love, and the reputation he acquires through his work among those who are qualified to judge it; popular recognition is out of the question, because the majority are not sufficiently educated to understand the high character of this labour: another man who, after a long course of study of books, men, and things, devotes himself to literature or to art has, in addition to these incentives, the pecuniary recompense arising from the sale of his productions, books, pictures, sculpture, &c. Is the work of the scientific inquirer into nature of less value to the commonwealth than that of the literary man or of the artist? Such modern *necessaries* of civilisation as gas, telegraphs, railways, printing, dyeing materials, glass, &c., would not have existed but for the work of the former; even commerce could scarcely have existed, as ocean navigation would be impracticable but for the discoveries of scientific men. Although in certain cases it might be difficult to say at once what *direct* benefit to the community would ultimately accrue from the prosecution of a research, yet it is evident from innumerable examples that *anything that adds to the knowledge really adds to the wealth of the community*.

Why could not a system of national, or even international, prizes and rewards for scientific research be instituted? True the requisite funds would ultimately come out of the pockets of the non-scientific part of the community; but does not the pecuniary reward of the literary man or of the artist ultimately come out of their pockets too? The purchaser of a book, picture, statue, &c., acquires the means of making the purchase by charging a higher price for the professional labour that he performs for others, for the goods he sells, for the houses or land that he lets, and so on; in the long run, the community at large bears the expense of the pecuniary rewards of literary men and artists, and profits in many ways by so doing. It can scarcely be doubted that great ultimate profit would also accrue if the labours of scientific men were also recompensed by the community; inasmuch as far more work of this kind would be done then than is now, and a corresponding increase of knowledge, *i.e.* wealth, would result.—I am, &c.,

GRADUATE.

London, April 23, 1872.

MISCELLANEOUS.

Complimentary Dinner to Dr. Moffat.—Dr. Moffat was entertained to dinner in the Tontine Hotel, Glasgow, on the 13th inst., by several of his students, in token of their high esteem of him as a teacher of chemistry. An excellent dinner having been partaken of, Dr. Cameron was called to the chair, who, after making a few appropriate remarks befitting the occasion, thanked Dr. Moffat, in the name of the students, for the kindness and courtesy shown to them by him. Several songs and recitations having been given, the party broke up, after a most agreeable meeting, each student bearing away with him a grateful remembrance of the kindness and abilities of his worthy teacher.

Quality of the Metropolitan Gas.—Dr. Letheby, the Chief Gas Examiner appointed by the Board of Trade, has recently submitted to the Corporation of London and the Metropolitan Board of Works his quarterly report of the quality of the gas supplied to London, by the Chartered, the Imperial, and the South Metropolitan Gas Companies from which it appears that the average illuminating power of the Chartered gas has been equal to that of 17·10 standard sperm candles at Beckton, 17·64 candles at Cannon Street, 17·92 at Friendly Place, 17·12 at Arundel Street, and 16·62 at Millbank Street. That of the Imperial gas has been 16·57 candles at Oakley Square, 16·02 at Camden Street, and 16·22 at Graham Street; that of the South Metropolitan having been equal to 15·82 candles. The Cannel gas of the Chartered Company has averaged 24·55 candles at Arundel Street, and 24·85 candles at Millbank Street. As regards purity, Dr. Letheby reports that the gas of all the companies has been constantly free from sulphuretted hydrogen, excepting that of the Chartered Company at Millbank Street, where it was twice found to be charged with this impurity. He reports, however, that this was caused by accidental circumstances over which the company had no control. The amounts of sulphur in other form than this have ranged from an average of 22·67 grs. in 100 cubic feet of the Chartered gas at Friendly Place to 42·59 grs. at Beckton—the proportions at each of the testing places having been as follows:—the Chartered gas at Cannon Street, 34·68 grs. per 100 feet; at Arundel Street, 35·52 grs.; at Beckton, 42·59; at Millbank Street, 27·58; and at Friendly Place, 22·67. That of the Imperial Company contained 37·03 grs. per 100 feet at Oakley Square, 25·56 at Camden Street, and 28·23 at Graham Street; and the gas of the South Metropolitan Company contained 31·27 grs. The proportions of sulphur in the Cannel gas of the Chartered Company were 23·01 grs. per 100 feet at Arundel Street and 26·59 grs. at Millbank Street. Dr. Letheby draws attention to the fact that the common gas at Friendly Place contained only 19·87 grs. of sulphur as the average amount during the whole of last year, and that there were 162 occasions when it contained less than 20 grs. per 100 feet, whereas, during the present quarter, the quantity of sulphur in the Beckton gas has averaged as much as 42·59 grs. He says, also, that the amount of sulphur in the Cannel gas at Cannon Street was only 11·20 grs. per 100 cubic feet in 1871, and that there were 225 occasions when it was under 20 grs., whereas in the present quarter it has amounted to an average of 23·01 grs. at Millbank St, and 26·5 grs. at Arundel Street. These facts show that the processes of purification and manufacture are not so perfect as they were in 1871. The quantity of ammonia in the gas has not been excessive, for it has ranged from 0·0 to an average of 0·6 of a grain in the gas at various places.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, April 1, 1872.

This number opens with an essay—

Theory of the Cause of the Aurora Borealis.—M. de la Rive.

This number also contains, in addition to several important papers relating to astronomy, meteorology, and natural history, the following papers and memoirs more particularly relating to chemistry:—

Second Instalment of a Memoir on the History of Fermentation.—Prof. E. Chevreul.—This portion of the excellent memoir is divided into the following chapters:—Stahl; analogy and difference existing generally between the ideas of Stahl and van Helmont; the chemical books edited by Stahl reviewed in their general bearing; Stahl's fermentation theory; Stahl's theory of combustion. The

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general conclusion to be drawn from these chapters is that the theories of Stahl on fermentation and combustion bear rather a *physical* than a *chemical* character.

Rinderpest.—Dr. Bouley.—The author, representative member for France at the international conference now holding its sittings at Vienna for the purpose of considering the means to be adopted for preventing the rinderpest (a disease originally endemic to the Steppes country of Russia) from being propagated, states, in a short note to Dr. Thenard, that practically this question has been settled. Particulars as regards the method are not communicated as yet.

Theoretical Considerations on the Thermometrical Scales of Temperature and on the Co-Efficient of Dilatation of the Permanent Gases.—Dr. Crova.—In consequence of a very severe critical attack made by Dr. Mohr (in his work "Mechanischen Theorie der Chemischen Affinität;" Bonn, 1868) upon the centigrade thermometer scale, which he (Dr. Mohr) considers to be as imperfect and arbitrarily made up as the scales of Cartier's and other areometers, and particularly to be suffering from the defect that for a given number of degrees the increase of temperature should not be the same, the author of this memoir (here only briefly mentioned in very short abstract, the original being published in the *Mémoires de l'Académie des Sciences et Lettres de Montpellier*) has investigated this subject, and points out the errors made by Dr. Mohr.

Spontaneous Motion of Liquids in Capillary Tubes.—C. Decharme.—A treatise on capillarity.

On Sorbite, a Saccharine Matter Analogous to Mannite, Met with in the Berries of the Sorbus Aucuparia.—J. Boussingault.—The introduction of this memoir is devoted to the communication of researches made by the author on the subject of the difference in quantity of alcohol obtained by distillers on the large scale as compared with the quantity which theoretically should be obtained. It appears that in some parts of the Continent the berries of the *Sorbus Aucuparia* (sorb-tree) are bruised and the juice fermented, yielding a kind of wine, in which the author has discovered the presence of sorbite, a sweet-tasted material, nearly insoluble in cold absolute alcohol, but soluble in that liquid when boiling. Sorbite may be obtained in the shape of crystals, which contain water of crystallisation and have the formula $C_{12}H_{15}O_{12}$, but when dried at 110° the formula is $C_{12}H_{14}O_{12}$; fusion-point, 65°.

Some Metallic Trichloracetates.—A. Clermont.—The author describes at considerable length the following salts of trichloracetic acid:—Of potassa, $KO,C_4Cl_3HO,C_4Cl_3O_3$, a beautifully crystalline substance, unalterable in air; gives off, when heated, abundant fumes of trichloracetic acid; it contains in 100 parts—Potassa, 12·90; carbon, 13·14; hydrogen, 0·27; chlorine, 58·34; oxygen, 15·35. Of oxide of nickel, $C_4Cl_3O_3,NiO,+4HO$; in 100 parts—Oxide of nickel, 16·44; trichloracetic acid, 67·76; water, 15·80. Of magnesia, $C_4Cl_3O_3,MgO,+4HO$; in 100 parts—Magnesia, 9·50; trichloracetic acid, 73·39; water, 17·11. Of lithia, $C_4Cl_3O_3,LiO,+4HO$; in 100 parts—Lithia, 7·29; trichloracetic acid, 75·18; water, 17·53. All these salts are crystalline, but the two last-named are very deliquescent.

Identity of Bromhydrate and Iodhydrate of Bromated Propylen with the Dibromhydrate and Iodobromhydrate of Allylen. Dibromhydrate of Acetylen.—E. Reboul.—Notwithstanding the very high scientific merits of this lengthy essay, its contents do not admit of any useful abstraction.

Annalen der Chemie und Pharmacie (double number), February and March, 1872.

This number contains the following original papers and memoirs:—

Methyl-Mercaptan-Trisulphonic Acid, Methyl-Mercaptan-Disulphonic Acid, and Methyl-Alcohol-Trisulphonic Acid.—M. Albrecht.—The contents of this lengthy monograph treat on the action of sulphite of potassa upon perchlor-methyl-mercaptan, $CSCl_4$, and the products of conversion of this reaction. We regret that, notwithstanding the high scientific value of this essay, it is not suited for useful abstraction, but we quote the headings of the different sections—Methyl-mercaptan-trisulphonic acid; origin of methyl-mercaptan-disulphonic acid from methyl-mercaptan-trisulphonate of lead; origin of the last-named acid from methyl-mercaptan-trisulphonate of silver; methyl-alcohol-trisulphonic acid and its salts; action of neutral sulphite of potassa upon sulpho-carbonyl chloride and upon sulphide of carbon.

Action of Sulphite of Potassa upon Bodies Containing CCl_3.—B. Rathke.—The leading idea of the researches here published at great length has been to ascertain whether a fixed rule could be found, according to which the Cl in the complex atom CCl_3 is entirely exchanged for SO_2K, or in part for H. The bodies investigated in this direction are—Trichlor-formen-sulphon chloride, $CCl_3.SO_2Cl$, and the potassa salt of this acid; chlor-picrin, $CCl_3.NO_2$; chloral hydrate, $CCl_3.COH+H_2O$; and trichloracetic acid, $CCl_3.CO_2H$. There is added to this lengthy essay a review, elucidated with a series of formulæ, exhibiting the results of the action of sulphite of potassa upon the group of bodies containing CCl_3.

Some Instances of the Formation of Chemical Compounds with Deficient Affinity.—B. Rathke.

Formation of the Fatty Alcohols from their Initial Atoms (Anfangsgliedern); Part 13—Synthesis of Normal Butyric Acid.—E. Linnemann and V. von Zotta.—The continuation of a lengthy and exhaustive monograph on this subject, Part 14 treating on the synthesis of normal butylic alcohol, and Part 15 on the pure normal butyl derivatives. To be continued.

Some of the Derivatives of Butyron.—Dr. C. M. Kurtz.—This memoir is divided into the following sections:—Action of dichromate of potassa and sulphuric acid upon butyron; action of nitric acid upon butyron; action of nascent hydrogen upon butyron; butyron-pinakon; action of chlorine and chloride of phosphorus upon butyron.

On Allyl-Sulphonic Acid and some of its Salts.—Dr. A. von Rad.—By a circuitous and rather tedious method, the author prepared, first, a double salt of allyl-sulphonate of potassa and iodide of potassium—

$$C_9H_5K_3S_3O_9I_2=3\left\{\begin{matrix}C_3H_5\\SO_3K\end{matrix}\right\}O+2KI,$$

and next converted it, by means of treating it with sulphuric acid, into allyl-sulphonate of potassa—

$$\left.\begin{matrix}C_3H_5\\SO_3K\end{matrix}\right\}O;$$

a baryta and a lead salt were also obtained, likewise a small quantity of free allyl-sulphonic acid, but not in a condition suited for further investigation.

Chemical Constituents of the Leaves of the Ampelopsis Hederacea, Wild Vine.—Dr. E. von Gorup-Besanez.—The leaves of this plant, gathered in June and in September last year, were investigated, and found to contain large quantities of free tartaric acid, bitartrate of potassa, tartrate of lime, gum, fermentable sugar, and a substance which became green-coloured with chloride of iron; while the ash was found to contain percentically the following substances:—Potassa, 24·62: soda, 1·74; chloride of sodium, 2·03; lime, 34·37; magnesia, 8·36; phosphate of peroxide of iron, 7·99; phosphoric acid, 5·84; sulphuric acid, 4·59; silica, 10·46. In September the leaves were found not to contain any bitartrate of potassa, but tartrate of lime was present, and also pyrocatechin.

Reaction for Ozone as Exhibited by the Air in the Neighbourhood of Gradation Machines of Salt-Works.—Dr. E. von Gorup-Besanez.—In the first place, we meet in this excellent essay with a well-digested review on the reagents for ozone, on the detection of ozone in air, and on the presence of nitrous acid in air, and of nitrate of ammonia in rain-water. Next, this memoir contains the detailed account of a series of experiments made with the view to elucidate the phenomenon alluded to, as observed at Kissingen close to the gradation machines of the salt-works situated in that locality. The result come to is that ozone is decidedly present in rather large quantity in the proximity of the works alluded to, though less than the quantity frequently present in the air on the sea-coast, or in the air some few miles distant from land at sea.

Normal Paraffins.—Dr. C. Schorlemmer.—Notwithstanding the high scientific value of this paper, its contents are not suited for abstraction.

On Anti-Combustion Substances.—A. Patera.—The introduction of this paper records a series of dreadful accidents and loss of life, occasioned by the ignition of the inflammable fabrics used as ladies' wearing-apparel. The author next reviews the various substances which have been proposed to be added to the starch or dressing used in making up the readily inflammable fabrics, so as to prevent, if not altogether the combustion of the same when taking fire, the fabrics bursting into flame. While highly approving of the use of tungstate of soda, the author yet thinks there may be substituted for it a cheaper material, viz., a mixture of 4 parts of borax and 3 parts of sulphate of magnesia; these salts are mixed together just before being required (otherwise insoluble borate of magnesia is formed too early), and then dissolved in from 20 to 30 parts of warm water, in which the fabrics are to be immersed, next wrung out, and then dried. A mixture of sulphate of ammonia and gypsum may be used for coarse fabrics.

Oxidation of Ketones.—A. Popoff.—The second instalment of a lengthy monograph on this subject.

Direct Oxidation of Anthrachinon by means of Hydrate of Potassa.—V. Wartha.—This paper only contains the statement that, notwithstanding the assertion to the contrary made by Graebe and Liebermann, the author's researches on this subject (published some two years ago) are correct, and that consequently anthrachinon can be directly converted into alizarine by means of fusing hydrate of potassa.

Researches on Sorbinic and Para-Sorbinic Acid.—R. Fittig and J. B. Barringer.—This excellent and very exhaustive memoir is divided into the following sections:—General introduction; sorbinic acid; hydrosorbinic acid and its salts; action of bromine upon hydrosorbinic acid; behaviour of hydrosorbinic acid with fusing caustic potassa; behaviour of sorbinic acid with bromine; para-sorbinic acid.

Contribution to our Knowledge on Benzyl Ether.—F. Sintenis.—Notwithstanding the high intrinsic value of this lengthy monograph, we can only quote here the headings of the different sections:—Benzyl-ethyl ether; action upon it of chlorine at the ordinary temperature and at its boiling-point; action of chlorine in the presence of iodine at the ordinary temperature; benzyl-methyl ether; chlorbenzyl ether; experiments with bromine and nitric acid; benzyl-phenyl ether; action of chlorine and bromine upon it at the ordinary temperature; products of substitution of benzyl-phenyl ether; action of chlorine upon benzyl-phenyl ether in the presence of oxide of mercury.

On Benzol Derivatives of Hydroxylamine.—W. Lossen.—The observation made respecting the foregoing essay also applies to this memoir, divided into the following sections:—Preparation of benz-hydroxamic acid and dibenz-hydroxamic acid; benz-hydroxamic acid, $NH_2(C_7H_5O)O$; salts of this acid; dibenz-hydroxamic acid—

$$NH(C_7H_5O)_2O;$$

salts of this acid; tribenz-hydroxy $N(C_7H_5O)_3O$.

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Crystallographic Researches of the Substances Quoted in the Preceding Essay.—Dr. C. Klein.

Artificial Conversion of Bilirubine into the Colouring Matter of Urine.—Dr. R. Maly.—The author describes in this preliminary notice how bilirubine, when dissolved in dilute caustic alkali, and then treated with sodium amalgam, is converted into a pigment which has many points of resemblance with that present in normal human urine. The author is engaged with further researches on this subject.

Les Mondes, March 28, 1872.

Precious Metals in Bolivia.—Rev. F. Moigno.—In the district of Chaco, a silver ore has been discovered which yields 12,000 ozs. of silver to the ton, and at Saint-André de Mochaca and at Vilaquil very rich veins of gold have been found.

Fossils in the Republic of Ecuador.—Rev. F. Moigno,—Near Punin, a large quantity of fossil bones have been found, belonging among others to the mastodon, fossil horse, and other animals of the tertiary and quaternary geological periods.

Rain of Stones.—Rev. F. Moigno.—It appears that a violent thunderstorm at Rosano (Italy) was some weeks ago accompanied by a fall of pebbles varying in size from a small cob-nut to that of a large-sized pigeon's-egg.

Rain of Sand.—Rev. Father Denza, S.J.—The author relates that at Palermo, Cosenza, and Pérugia (Italy), there was clearly observed on March 4 and 10, at the respective observatories of these places, a rain of sand, which, on being viewed with the microscope, was ascertained to be due to the African desert. This phenomenon is not at all rare in Italy, and is well known also at Malta; the sand is carried over by the wind under certain circumstances.

Magneto-Electric Machine with a Continuous Current.—M. Gramme.—The lengthy description of a neat contrivance, illustrated by several woodcuts.

Tramways and Railways for Large Cities.—F. Michel.—This paper, illustrated by several woodcuts, deserves the attention of parties interested in this subject.

Dry Distillation of Wood.—P. Chipoff.—A very complete and practical account of this industry as carried on largely in Russia. This memoir is illustrated by engravings.

April 4, 1872.

Carbonate of Lead instead of Red-Lead for Crystal Glass.—M. Clernandot.—By the use in the glass mass of white-lead prepared by the Dutch method, the author obtains a more perfectly colourless glass than by the use of red-lead, because the latter is not quite so free from iron as the best white-lead, and it is the iron which imparts to the crystal glass a greenish hue.

Introduction of the Metrical System in the Austro-Hungarian Empire.—The official Gazette of Vienna of March 2 contains the Law of July 23, 1871, whereby the metrical system is to be introduced in the empire just named. The standard metre is a glass rod which, at the temperature of melting ice (0°), has a length of 999·99764 millims. The standard kilogramme is a crystal glass cube, the weight of which *in vacuo* is equal to 999·9978 milligrms. (both standards having been made according to the great platinum standards which are at Paris). The new system is to be in full compulsory force from Jan. 1, 1876, but in all official works the new system will be required to be adhered to on and after Jan. 1 next.

Preparation of Potassium.—Dr. Dolbear.—The author converts caustic potassa into sulphuret of potassium by passing sulphuretted hydrogen through the aqueous alkaline solution; this is evaporated to dryness, then intimately mixed with iron-filings, and next submitted to distillation in an iron retort heated to bright red heat, and the product of the distillation collected under the surface of refined coal-tar oil.

Osseine, Gelatine, Osmazome.—E. Monier.—In this essay the author expounds the divers nutritive and physiological properties of the three substances just named, which are often confused together. Osseine is nutritive, as proved in the case of dogs, wolves, and similar animals, who can digest bones and excrete the inorganic matter. Gelatine alone, and osmazome (largely contained along with salts in extract of meat), are not by themselves nutritive, but, as regards especially the latter, aid the digestion as a condiment.

Bibliography.—Under this heading we call attention to—"Traité Elémentaire de Chimie Organique," par M. Berthelot, Professeur au Collège de France, &c.; 1 vol., grand 8vo.; Dunod, éditeur; Paris, 1872. This work contains the *resumé* of the author's lectures on this subject as delivered for a period of twelve years. This work is here highly spoken of for its clear style and great completeness; no less than 10,000 organic compounds have been hitherto discovered, made, and studied, and the number which may be made is literally unlimited. Although not quite belonging to the books which we usually quote, we just mention, as we find it in the above-named periodical cited for curiosity's sake, the following:—"Journal d'un Diplomate en Italie Notes Intimes pour Servir à l'Histoire du Second Empire (1859-62)," pour M. Henry d'Odeville; Hachette, éditeur; Paris, 1872.

Revue Universelle des Mines, de la Métallurgie, des Travaux Publics des Sciences et des Arts Appliquées à l'Industrie, No. 6 (double number), November and December, 1871.

This number does not contain any original papers relating to chemistry, but we call attention to a memoir—

Coal-Mining Industry of the Basin of the Don (Russia).—M. Semiatchkine.—The author states in the introduction that coal was discovered in this region by Peter the Great, who said on that occasion "Ce mineral sera utile, sinon à nous, du moins a nos descendants;" words which have been fully verified, as may be learned from the details of this memoir, which strongly exemplifies also the might of "Old King Coal" even in the far and remote south-east of Russia.

Bibliography.—Under this heading we call attention to a work which appears to be published in separate parts simultaneously in the German and French languages; the German title is "Wissenschaftlich Technisches Handbuch des Gesammten Eisengiesserei Betriebes," by E. F. Dürre, Professor of Metallurgy at the Royal Polytechnic School of Aix-la-Chapelle; published at Leipzig by A. Félix. From the review before us, it appears that this important work deserves to be in the hands of all who are interested in the theory and practice of the iron-smelting industry.

This number contains several important papers relating to engineering and railways.

NOTES AND QUERIES.

Estimation of Nitrogen by Combustion.—In a note printed in the last number of this journal, Mr. John Ruffle states that the nitrogen of the alkaline nitrates can be converted to and estimated in the form of ammonia by the soda-lime process, or a modification thereof. Having very frequently to estimate the nitrogen in manures containing nitrate of soda, I have found that Dumas's method is the only one extant by which the whole of the nitrogen can be determined. As examples of this I subjoin the results of the analysis of two samples of manures, both containing nitrate of soda, and tested by both methods—

	Percentage of nitrogen.	
	By Dumas's method.	By soda-lime method.
No. 1 sample	4·78	3·17
,, 2 ,, ...	3·85	2·90

Being acquainted with the mixing of each sample I was enabled to know that the results by the soda-lime method were too low. I have also tried the effect of the soda-lime combustion on pure nitrate of soda, the result showing that not a trace of ammonia is evolved. It would be a great advantage to have a method less costly and troublesome than Dumas's for estimating the total nitrogen in mixed manures, and if Mr. Ruffle will explain the nature of the "modifications" he has adopted, and the results he obtained, he will confer a benefit.—WALTER TATE.

MEETINGS FOR THE WEEK.

MONDAY, April 29th.—Medical, 8.
—— London Institution, 4. Prof. Bentley, "On Elementary Botany."
—— Zoological, 1. Anniversary.
TUESDAY, 30th.—Civil Engineers, 8.
—— Royal Institution, 3. E. B. Tylor, F.R.S., "On the Development of Belief and Custom amongst the Lower Races of Mankind."
WEDNESDAY, May 1st.—Society of Arts, 8.
—— Microscopical, 8.
—— Royal Institution, 2. Annual.
THURSDAY, 2nd.—Royal, 8.30.
—— Royal Society Club, 6.
—— Royal Institution, 3. Dr. Tyndall, LL.D., F.R.S., "On Heat and Light."
—— London Institution, 7.30. Fourth Musical Lecture.
—— Chemical, 8. E. Riley, Esq., "On the Manufacture of Steel."
FRIDAY, 3rd.—Royal Institution, 9. W. Spottiswoode, L.LD., F.R.S., "On Optical Phenomena Produced by Crystals when Submitted to Circularly Polarised Light."
—— Geologists' Association, 8.
SATURDAY, 4th.—Royal Institution, 3. R. A. Proctor, Esq., B.A., "On Star-Depths."

BOOKS RECEIVED.

Chimie Organique Elémentaire Leçons Professées a la Faculté de Médecine. Par Edouard Grimaux. Paris: Librarie Germer Baillière.

A Series of Chemical Labels for Use in Laboratories, &c. Published by Mottershead and Co., 1, Market Place, Manchester.

Proceedings of the American Pharmaceutical Association at the Nineteenth Annual Meeting. Philadelphia: Sherman and Co.

Elements of Chemistry, Theoretical and Practical. By William Allen Miller, M.D., D.C.L., LL.D. Revised by Herbert McLeod, F.C.S. Part I., Chemical Physics. Fifth Edition. Longmans and Co.

The Journal of the Iron and Steel Institute. Vol. I., 1872. London: E. and F. N. Spon.

Third Annual Report of the State Board of Health of Massachusetts. Boston: Wright and Potter.

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THE CHEMICAL NEWS.

Vol. XXV. No. 649.

THE ESTIMATION OF NITRIC ACID IN POTABLE WATERS.

By THOS. P. BLUNT, M.A., F.C.S.

The following process for the estimation of nitric acid in potable waters will be found specially applicable in the case of the adoption of Wanklyn and Chapman's "ammonia process." It is a modification of one published some time ago by Mr. Vernon Harcourt.

The final residue of the distillations with hydrate and permanganate of potassium is transferred from the retort to a flask, which it should about one-third fill; it is raised to ebullition, and successive small quantities of sulphite of soda free from ammonia are added, until the whole of the permanganic acid has been reduced to the brown oxide; a few grains of recently-ignited charcoal powder are then introduced into the flask, and afterwards some aluminium foil, weighing eight or ten times as much as the nitric acid judged to be present; the flask is immediately connected, by a cork and bent tube, with a small Liebig's condenser, the other extremity of which, prolonged by a piece of glass tube with india-rubber connection, dips beneath the surface of some distilled water, free from ammonia, half filling a small beaker. When the evolution of hydrogen has nearly ceased, heat is applied, and distillation is carried on until about two-thirds of the liquid in the flask have passed over into the beaker, which will then contain in the form of ammonia the whole of the nitrogen contained in the nitric acid of the water.

The distillate is then transferred to a measuring flask, and the latter is filled up to the mark with distilled water; after mixing perfectly by agitation, one-tenth of the whole is measured off with a pipette, conveniently diluted, and the ammonia estimated by the Nessler test in the ordinary manner.

Should the ammonia in one-tenth of the distillate be insufficient to give a decided tint with the test a larger proportion may be taken, the amount being of course in each case calculated upon the whole, and ultimately estimated as nitric acid by the necessary proportion (1:3·7).

The object of the addition of the charcoal powder is to prevent the violent and troublesome bumping which usually occurs during the ebullition of caustic alkaline fluids; it will be found very useful in the ammonia process itself, where the tendency to turbulent boiling is still further aggravated by the permanganate of potassium used in the last stage.

ESTIMATION OF NITROGEN.

By BEAUMONT J. GROSJEAN.

With reference to Mr. Ruffle's communication on the above subject in the Chemical News (vol. xxv., p. 189), I may remark that it has for some time been known and mentioned in text-books that the nitrogen in nitrates is partially evolved as ammonia on heating with soda-lime. Thus, in Church's "Laboratory Guide" (1st. ed., p. 48), the analyst is directed to employ, in a determination of nitrogen, soda-lime "free from nitrate." Fresenius, in his "Quantitative Analysis" (4th ed., p. 453), refers indirectly to the same fact.

It is particularly desirable that some ready means should be devised of estimating nitrogen in substances like manures, which sometimes contain that element in three forms, viz., as organic nitrogen, as ammonia-salt, and as nitrate. It may be some aid towards attaining this object if I state a few experiments I have made.

The first experiment, which was suggested by Mr. R. Warington, was made with the view of determining the nitrogen in a nitrate by a modification of the well-known method in which platinised zinc, or zinc and iron filings, evolve the nitrogen as ammonia from an alkaline solution. A combustion was made with 0·768 grm. pure nitre, 22 grms. soda-lime, and 2 grms. iron filings. The nitrogen obtained was only 15·52 per cent of that employed. The employment of 5 grms. iron filings, in another experiment, gave a better result, viz., 26·86 parts nitrogen for 100 used. The third experiment was the same as the preceding with the addition of 0·75 grm. pure cane-sugar, which, it was hoped, would assist in the reduction of the nitrate. In this case the nitrogen obtained was 53·5 per cent of that put in. The progressive success of these experiments is an encouragement to proceed in a similar direction.

I then thought that if the nitrate in a substance containing also organic nitrogen could be decomposed in an alkaline solution by iron alone, a combustion could be made of the residue, and thus the remaining nitrogen obtained: it will at once be seen that the presence of zinc would greatly interfere with a combustion. 0·5 grm. pure nitre was placed in a retort, with 3 grms. iron filings, and soda solution (previously freed from nitrate by boiling with iron filings), and distillation carried on as usual. The percentage of nitrogen obtained was 14·47, theory being 13·85, showing an excess of only 0·62 per cent. There is no doubt that aluminium would answer the purpose still better, though it would involve more expense. It is only necessary to distil two-thirds of the contents of the retort to obtain by this means all the nitrogen present as nitrate and ammonia-salt. In the case, however, of substances containing also organic nitrogen, it would be necessary to carry the distillation still further, since I propose that, in such cases, a combustion should be made of the residue, and in the requisite evaporation to dryness some of the organic nitrogen would be evolved as ammonia and lost. I find it, however, unnecessary to carry the distillation to perfect dryness. If the mass in the retort be of the consistency of thin paste while hot, it will, when cold, be perfectly solid, and can then be powdered and submitted to combustion in the usual way. The latter part of the distillation is considerably accelerated by attaching an aspirator to the U-tube, which, with a tubulated receiver, contains standard acid to neutralise the ammonia; the pressure on the surface of the contents of the retort being lessened, distillation proceeds more quickly.

Since it is difficult to get the whole of the residue out of the retort with accuracy, I recommend the following plan:—Put an equal quantity of the substance to that treated as above into a beaker containing water, iron filings, and soda-lime which has been previously freed from nitrate if necessary, and carry evaporation on to the same point and at the same temperature as in the retort. This may be ensured by performing both operations in an oil-bath. While still pasty, the residue should be turned into a dish, the beaker freed from any that remains by means of water and weak acid, and the contents of the dish, after drying, powdered, and submitted to combustion. The ammonia thus obtained, added to that furnished by distillation, should give the total nitrogen in a substance containing organic nitrogen, ammonia-salt, and nitrate.

I think the direction has been indicated in which success may be expected, but further experiments are needed before the method can be deemed complete. Thus it may be mentioned that the addition of zinc to the retort containing a manure made with nitrate in alkaline solution, resulted in the production of more ammonia than when iron alone was used. I have, however, shown that the presence of zinc is not necessary with a pure nitrate, and

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it is remarkable that the authors and improvers of this method of estimating nitrogen in nitrate differ widely in the quantities they employ. Thus Harcourt employs 100 grms. zinc and 50 grms. iron for 1 grm. nitre, while Siewert uses 10 grms. zinc and 4 grms. iron.*

Perhaps a combustion of a nitrate with soda-lime in a current of hydrogen would furnish all the nitrogen in the form of ammonia.

QUALITY OF THE WATER SUPPLY OF LONDON.†

By H. LETHEBY, M.B., M.A., Ph.D., &c.,
Medical Officer of Health for the City of London.

THIS, as heretofore, has been the subject of regular investigation, not only in respect of the quality of the water supplied to the City, but also of that supplied to the whole Metropolis; and the principal facts of the inquiry are classified in the following table:—

Average Chemical Composition of the Metropolitan Waters for the year 1871.

Names of Water Companies, &c.	Total solid matter per gallon.	Common salt.	Oxygen required by organic matter, &c.	Nitrogen. As nitrates, &c.	Nitrogen. As ammonia.	Hardness. Before boiling.	Hardness. After boiling.
	Grs.	Grs.	Grs.	Grs.	Grs.	Deg.	Deg.
THAMES WATER COMPANIES.							
Grand Junction	19·56	1·88	0·102	0·128	0·003	14·8	3·8
West Middlesex	18·71	1·83	0·040	0·124	0·001	14·4	3·3
Southwark and Vauxhall	19·44	1·91	0·089	0·125	0·003	14·8	3·8
Chelsea	19·48	1·87	0·093	0·136	0·003	14·9	3·3
Lambeth	19·79	1·79	0·082	0·123	0·003	15·0	3·8
OTHER COMPANIES.							
Kent	27·69	2·56	0·010	0·215	0·000	20·7	5·7
New River	19·19	1·68	0·032	0·132	0·001	14·8	3·5
East London	20·39	2·10	0·060	0·143	0·001	15·0	4·0

The quantity of solid or rather saline matter dissolved in the water supplied to London during the year has ranged, in the case of the Thames supply, from 18·71 grs. per gallon (West Middlesex Company) to 19·79 grs. (Lambeth Company); in the New River Water, which is that chiefly supplied to the City, it has averaged 19·19 grs. per gallon; in the River Lea water of the East London Company, 20·39 grs.; and in the water from the deep chalk wells of the Kent Company it has amounted to 27·69 grs. per gallon. The fluctuations of these proportions have not been considerable during the year, although in all cases the water has contained more saline matter in winter during wet weather than in summer—the maximum being in January and February, and the minimum in September. The hardness of the general supply has ranged, in the case of the river water, from 14·8° to 15° of Clark's scale, and this has been reduced to about 4° by boiling for a quarter of an hour. In the case of the chalk-well water, the hardness has been 20·7°, and after boiling it has fallen to 5·7°. The proportion of organic matter in the water has been very small, for the quantity of oxygen required to act on every description of oxidisable matter has ranged from only 0·01 of a grain per gallon in the chalk water of the Kent Company, to 0·102 of a grain in the Thames water supplied by the Grand Junction Company: and the amounts of ammonia and of organic nitrogen, as determined by Wanklyn's process, have not exceeded the 100th part of a grain per gallon of water.

As regards turbidity, the water supplied to the City by the New River and the East London Companies has been invariably bright and nearly colourless, and so also has been that of the Kent and the West-Middlesex Companies, but that of the Southwark and Vauxhall Company has been turbid on one occasion, that of the Lambeth Company on five occasions, and that of the Chelsea and of the Grand Junction Companies on eight occasions respectively. The turbidity has been at all times due to the presence of a very small quantity of finely-divided clay in which there was occasionally a trace of vegetable tissue; and no doubt it had been caused by the heavy floods of the river. Although perfectly harmless, a slight turbidity of the water is sure to command attention, and may easily be made the subject of popular clamour. On several occasions it has been described by the Registrar-General on the authority of Dr. Frankland in very alarming language, as that the water was turbid, very muddy, contained living organisms, was polluted with organic impurity, and was entirely unfit for domestic use. It is fortunate for both the water companies and the public that the Board of Trade has power, under the 35th and 36th section of the Metropolis Water Act, 1871, to institute inquiries into the truthfulness of such statements; and, accordingly, at the instance of the vestry of St. Mary, Newington, who were terrified beyond measure at the accounts given by Dr. Frankland of the condition of the water supplied to the parish, the Board of Trade appointed their officer, Major Bolton, who is the water examiner, to investigate the facts of the case; and in his report, which I have before me, he verifies the statement of Dr. Frankland as to the occasional turbidity of the water supplied by the Lambeth and the Southwark and Vauxhall Companies, and as to the presence of living organisms, but he attaches so little importance to the fact, that he says, "it is to be regretted that such terms as 'living organisms' and 'moving organisms' have been used so frequently and so indefinitely;" for not only do they exist in all water, but "it is impossible altogether to get rid of the simplest forms of vegetable and animal life, which should be understood by such terms, even by the most perfect filtration;" and in proof of the wholesomeness of Thames water, when properly filtered, he quotes from the Report of the Royal Commission on the quality of the water from the Thames Basin, to the effect that "in the present state of chemical science, analysis fails to discover in properly filtered Thames water anything positively deleterious to health. Whatever may be the difference of opinion with respect to the time required for removal of all the objectionable organic matter, all chemists agree that in Thames water taken from the present source, and properly filtered, all such matter has disappeared, and that the resulting compounds, such as nitrates, &c., remaining therein, are innocuous and harmless." Dr. Frankland, however, who is not a medical man, is not altogether of this opinion, for he thinks that water once charged with organic impurities is for ever after dangerous, and hence he uses the sensational phrase of "previous sewage contamination"—attributing all the combined nitrogen in water, with a small deduction for that which may have been acquired from the atmosphere during its fall as rain, to sewage or other such contamination; but the phrase, as Major Bolton remarks, is more alarming at the first glance than when closely examined; for it really implies—not that sewage or organic matter is contained in the water, but that the metamorphosed elements of these matters are present; and so they are in all the food we eat, for the corn, the fruit, the vegetables, and even the wine produced upon land manured with organic matter, must contain the metamorphosed elements thereof, and must, in the peculiar language of Dr. Frankland, be the products of "previous sewage or manure contamination;" but who cares for this when the meaning of the phrase is clearly understood? It is, however, unfortunate that the Registrar General should continue to employ it—seeing that it is constantly being misunderstood, and, therefore creating unnecessary alarm in the public mind. As an illustration of this I may refer to

* Fresenius's "Quantitative Analysis." 4th ed., p. 348.

† From the "Report on the Sanitary Condition of the City of London, for the year 1870-71."

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a report of the recently appointed medical officer of health for Lambeth, wherein he states that the water supplied to his district is "extensively diluted sewage." The publication of such a statement is sure to excite the gravest apprehension, which, as might be expected, is not confined to the district in question, but extends to the whole Metropolis. Officers of health have therefore had to allay the feeling of alarm, and in one case it has been made the subject of a special report. Thus Dr. Whitmore, who, like myself, has been engaged for years past in examining the water of his district, gives assurance to his vestry that it is "excellent in quality and perfectly wholesome." The subject has also commanded the attention of Dr. Alfred Swaine Taylor, F.R.S., the Professor of Medical Jurisprudence, and late Professor of Chemistry at Guy's Hospital, whose published report is before me. "There has been of late years," he says, "a great outcry on the subject of 'sewage contamination,' and some sanitary reformers have gone so far as to describe the Thames water as so much 'diluted sewage,'" "Dr. Whitmore," he says, "finds neither sewage nor the products of sewage decomposition in the water supplied by the West Middlesex Company. This," he adds, "is quite in accordance with the results which I have obtained by the examination of the water supplied to my house. Since the threatened approach of cholera in 1870-71, I have, for my own information, frequently examined the water for the products of decomposition, but have found none. As to 'previous sewage contamination,' I believe it to be a myth, if we are to understand thereby that the presence of sewage-products in water at any previous time renders that water noxious or unfit for use ever after. Those who adopt this theory can have but little faith in chemistry, or in the chemical changes which are going on around us;" and with regard to the phrase "living organisms," he says "if water is to be condemned as unwholesome and unfit for domestic use, because 'living and moving organisms,' *i.e.*, animalcules, are found in it, then there is no water in the world which can escape condemnation. The waters of the lakes of Wales and Cumberland, and even the water of Loch Katrine of Scotland, which is commonly taken as a type of purity for domestic use, would, on this ground, be pronounced 'undesirable for human consumption.' In short, those who would keep these minute infusorial animalcules out of any river or lake water on the earth, must adopt some scheme for preventing water-plants from growing in the water, or leaves, grass, or other organic substance from falling into it."

But the Registrar-General is not content with the use of these objectionable phrases, having reference to the quality of the water, and which are frequently associated with some statement respecting the dangers of cholera or typhus, and the connection of these diseases with bad water, but the quantities of the so-called impurities of water are represented in enormous proportions, as in thousands of tons. Dr. Taylor, however, thinks that "a gallon of water is an intelligible quantity. A man," he says, "may easily calculate within what period of time he consumes a gallon by daily use, and with it the 21 grs. of innocent solid substances contained in it. This is preferable to a system now adopted of giving the assumed constitution of 100,000 tons, or a corresponding number of kilogrammes or cubic metres of water. So enormous a quantity is, of course, beyond the reach of chemical analysis, and the tons of chalk, salt, and organic matter said to exist therein are only arrived at by multiplication. A ton of water represents 224 gallons. Within what period of time will a ton of water be consumed by any unit of the community? The answer to this question will show that such modes of laying plain matters before the public are more sensational than practical." The Royal Commission on Water have expressed themselves to the same effect, for at page 93 of their report, after condemning the term "impurities" as used by Dr. Frankland, they say, "And further, we cannot but consider it unphilosophical when, in addition to treating as 'impurities' substances perfectly harmless even in much larger quantities, the minute quantities present in a gallon, or any other small measure of water, are multiplied by taking masses of water, such as the individual never has to deal with, and given to the public in figures so large as to tend to cause misconception, and perhaps unnecessary alarm in the minds of those not conversant with all the conditions of the case."

I have been tempted to discuss this matter somewhat fully by the desire to allay any feeling of apprehension in the public mind as to the wholesome quality of the water supplied to this Metropolis, and I have endeavoured to show that although the phrases made use of by the Registrar-General on the authority of Dr. Frankland are at first sight undoubtedly alarming, yet when closely examined they are found to be but mere figures of speech, with, perhaps, a rather bold touch of exaggeration. It is, however, satisfactory to know that this kind of phraseology is quite exceptional, and is not used or even accepted, so far as I am aware, by any practical sanitary authority.

THE LOGWOOD TEST FOR ALUM IN BREAD.

By GEORGE E. DAVIS.

SOME time since a few samples of bread were sent me for analysis; they were supposed to contain alum. Knowing that the logwood test was the one most easily applied, but remembering also the letters (CHEMICAL NEWS, vol. xxiv., pp. 131, 134, and 154) relating to the subject, I thought that before I applied the test I would experiment with certain salts upon pure water coloured a straw-colour with an alcoholic solution of logwood; for in the above letters upon the subject, one analyst states the colour for alum and logwood to be *deep purple* or *violet blue*; on page 134 the colour is stated to be *dark red*; whilst Mr. Richard Weaver, on page 154, states that he obtained two colours from different samples of bread operated upon, *purple* and a *fine blue*. It was to obtain some reliable information on this alum test, or rather the logwood reagent, that the following experiments were performed:—

The alcoholic extract of logwood was prepared as follows:—50 grms. of ground logwood was digested with 350 c.c. of methylated spirits in a warm place for twelve hours; the solution was then filtered into a stoppered bottle. One drop of this alcoholic solution gave a beautiful straw-yellow colour with 50 c.c. of distilled water, and this coloured solution was used in all the following experiments:—

It is to be remembered that all the reagents were applied to the straw-coloured solution in an extremely diluted state.

(1). To 50 c.c. of the straw-yellow solution in a conical precipitating glass, a few c.c. of a dilute solution of aluminium sulphate were added; for an instant the straw-yellow gave place to a bright yellow, then the solution became purple-red, and, after standing twelve hours, a purple. The colour was identical with a solution of permanganate of potash in water—in fact not to be distinguished from this latter—for when obtaining a solution of permanganate exactly similar in tint, I happened to be called away, and on returning, forgetting which was the logwood glass, I had to apply a chemical test to discover it. The reagent I applied was hydrogen sulphite, and of this acid I shall treat hereafter in connection with the logwood test for alum. Soda alum, potash alum, and ammonia alum each gives the same reactions as aluminium sulphate.

(2). To a similar quantity of the straw-yellow solution a solution of normal sodium tartrate was added, and a dark red with a brownish tinge was obtained. Rochelle salts and also ammonium tartrate gave the same reactions. *Two drops* of hydrogen sulphite solution were then added,

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and the dark red colour of the solution gave place *instantly* to the straw-yellow. *Two drops* of the hydrogen sulphite were then added to the colour produced by the alum; the colour was unchanged, although, after standing an hour, the colour was decidedly weakened. A very large excess of the hydrogen sulphite failed to destroy the reddish tinge of the solution. This experiment I hold important, for if "baking powders" have been used in the manufacture of the bread, sodium tartrate would be the ultimate product, and as "baking powders" are usually made up of a slight excess of the bicarbonated alkali, the next experiment also bears upon the point.

(3). When a dilute solution of a monocarbonated or caustic alkali was added to the test solution a dark red colouration was immediately formed, which gave the straw-yellow on adding two drops of hydrogen sulphite.

(4). To the test solution a few c.c. of a dilute solution of disodium hydrogen phosphate were added, when the alum colour was *nearly* imitated, it being a decided red-purple, and resembling potassium permanganate in an acid solution. This colour also turned straw-yellow on adding two drops of hydrogen sulphite. I may as well add that the solutions of all the reagents were made with pure distilled water, and the reagents themselves were carefully re-crystallised, and also that great care was taken to have the solutions perfectly neutral.

(5). Dilute ferric chloride gave with the test solution a blue-black colouration, which, when largely diluted, appeared very blue; in fact, a rich purple blue.

(6). Traces of ferrous sulphate gave also a blue-black, and both these colours give place to the straw-yellow on adding hydrogen sulphite.

(7). Ammonium hydrate was next added. Traces gave a red-brown which, upon further addition, turns violet and violet blue, and on neutralising the alkali with hydrogen sulphite the straw-yellow returns.

(8). Copper sulphate solution was now tried; it gave a purple colour, decidedly a *bluish purple*, more so even than alum, turning more blue on being allowed to stand, becoming, in fact, nearly a violet after the expiration of six hours. This blue-purple colour is replaced by the normal straw-yellow upon the addition of two drops of the hydrogen sulphite solution.

(9). Fifty c.c. of the water from the tap in the laboratory were taken and coloured with one drop of the logwood tincture, when the solution became tinged exactly as the alum solution, for when placed side by side they could not be distinguished; two drops of hydrogen sulphite were then added; the tap-water returned to the normal straw-yellow, whilst the alum solution was scarcely affected.

Now, the question forced itself upon me: If this water were used for bread-making, how would the bread produced comport itself with the logwood reagent? This could only be answered by a direct experiment, and, on testing the bread made with the water the straw-yellow colour of the logwood solution was not altered, but bread made with the water, the flour having had alum added to it purposely, gave a decided reddish-purple colouration, which was not changed to purple-blue on standing, nor turned to straw-yellow on addition of a drop of concentrated hydrogen sulphite solution. Most of the acids bring back the red colours to straw-yellow, but I prefer to use hydrogen sulphite, as it is a weak acid and can be only driven off by heat if required.

We have, then, three distinct colours having some resemblance to each other but varying in tint, and by the above experiments I think I have shown that this resemblance of colour is no hindrance to the detection of the alum colouration, for all the colours are turned yellow except the alum where the solutions are acidified with hydrogen sulphite.

I know from conversations with various analysts upon the subject of alum in bread, that the logwood test is not of very high repute, and this acted upon me as an incentive to find what action other salts had, when present in traces, upon the logwood reagent.

Mr. Richard Weaver says, upon p. 154, vol. xxiv., that all the specimens which gave a blue colouration with the logwood test contained potatoes; this induced me to try potatoes *by themselves*. A decoction of the potatoes, both baked, boiled, and raw, gave a similar colour to the sodium phosphate, which was immediately turned yellow upon adding one drop of hydrogen sulphite. I tried many kinds of potatoes, and obtained many tints, but those tints *never* approached even a blue.

A sample of bread was then tested which was known to contain potatoes, and it was found that it gave a colour identical with that which the potatoes (which it contained) gave, but that colour would never be mistaken for the alum colour, for although it had a tinge of purple, yet it was decidedly red, which immediately became straw-yellow on adding hydrogen sulphite solution. Will other chemists give their experience of this logwood test?

Radcliffe, April 16, 1872.

THE SUCCESSIVE ACTION OF SODIUM AND IODIDE OF ETHYL ON ACETIC ETHER

CRITICALLY EXAMINED AND INTERPRETED ON THE PRINCIPLES OF THE TYPO-NUCLEUS THEORY.

By OTTO RICHTER, Ph.D.

PROFESSOR FRANKLAND and Mr. Wanklyn, the two distinguished chemists to whose original and extensive labours the lovers of science are indebted for so many solid and valuable materials, will, I fear, consider it an act of great presumption on my part that I should have chosen for the theme of my present communication "the successive action of sodium and iodide of ethyl upon acetic ether;" more especially when it is seen that I have no new facts to contribute, and when I cannot but know that these gentlemen, who are leading authorities on this subject, differ greatly in their description of the concomitant phenomena, although it is urged by the latter chemist, and, I believe, tacitly admitted by the former, that, notwithstanding these discrepancies, the chief products of the reaction are absolutely identical. Under these circumstances, most people would think it absurd and preposterous to select such an unfinished and evidently very intricate case for the theme of theoretical speculations. Nevertheless, when I put into the other scale of the balance the all-important object I have in view—viz., to vindicate the superior claims of the "typo-nucleus" theory over the still prevailing, but, in my opinion, unsound and unprofitable, doctrines of the "typo-radical" theory; when I can give convincing proof that the purer rays of light which emanate from the centre of that theory are capable of illuminating some of the darkest features of this hitherto inscrutable problem; in short, when the consciousness of a good and noble cause prompts me to persevere to the utmost, I feel confident that the parties alluded to, as well as the profession at large, will not refuse to accept this special plea as a sufficient apology for what might otherwise be censured as a great want of tact and common sense. It is on these exceptional grounds that the reader is now requested to lend an indulgent ear to the lucubrations of an honest and candid inquirer, who will consider himself amply rewarded if competent judges would kindly condescend to subject his theory to the ordeal of an impartial but severe criticism.

The successive action of sodium and iodide of ethyl on acetic ether has engaged the attention of some of our most experienced chemists, but it is chiefly to the profound and elaborate researches of Professor Frankland and Mr. Wanklyn that I am indebted for positive and reliable information on this subject. No doubt a great deal remains to be done, for the practical difficulties with which this question is surrounded are neither slight nor few. A considerable obstacle to our gaining a deeper

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insight into the precise nature of the various processes which have given birth to such an abundance and diversity of substances has, however, lately been removed by the important discovery that the seemingly contradictory statements of different observers are perfectly reconcileable on the experimentally well-grounded hypothesis that there exists an intimate relation between the degree of gaseous pressure which is brought to bear upon the mixture of sodium and acetic ether, and the quantity of hydrogen which is evolved during the reaction. Indeed, on the trustworthy authority of Frankland, who was in the habit of conducting his experiments under the ordinary atmospheric pressure, torrents of hydrogen gas nearly equal in bulk to the calculated theoretical amount were being emitted during the whole course of the operation; while, on the equally trustworthy authority of Wanklyn, who was in the habit of performing his experiments in sealed tubes, and consequently under a much higher degree of pressure, only a very small quantity of this gas, and sometimes none at all, could be detected. Now there appears to me nothing peculiarly remarkable in the simple fact that alterations of pressure may exercise a certain modifying influence in all those cases where the evolution of gas forms one of the prominent features; but what strikes me as something very strange and mysterious is the almost incredible, but apparently well-founded, assertion, that, notwithstanding these extreme variations in the quantity of eliminated hydrogen gas, the chief products of the reaction, inclusive of a certain number of their derivatives, are strictly identical. Wanklyn, at all events, declares them to be so, while Frankland, from not openly contradicting this statement, seems to be of the same opinion. Impelled by an irresistible desire to fathom and penetrate the mystery of these reactions, I resolved to examine this singular case through the powerful microscope of my "typo-nucleus" theory. The following is a brief summary of the information I have been able to gather with the aid of this, to me, invaluable instrument:—In the first place, I was not slow in perceiving that I had to deal with one of those rare and exceptional cases, where two *distinct kinds of chemical action* may be provoked in the same solution by simply altering the degree of *external pressure*. In the second place, I convinced myself that the chief products which emanate from these two modes of action, as well as the derivatives obtainable from these products, were not *identical*, but only *isomeric*. On these premises it became at once intelligible to me why Frankland, who was always experimenting at the one extremity of the scale of gaseous pressure, should have realised that set of compounds only, the production of which involves the disengagement of hydrogen gas in quantities exactly proportionate to the number of sodium molecules substituted for it, whilst Wanklyn, who was always experimenting at the other extremity of the scale of gaseous pressure, should have realised that set of compounds only, the production of which precludes the evolution of hydrogen gas. Having now acquainted the reader with the different, and in one sense also opposite, methods of proceeding which these two acute and careful observers thought proper to follow (and in the interests of science it was very fortunate that they did so), and having introduced to him the most eminent contributors of materials to what, I fondly hope, will soon stand out as a noble and everlasting monument to the skill and perseverance of competitive genius, it is meet that we should likewise engrave thereon the honoured names of artists who, like Löwig, Geuther, Lippmann, Wislicenus, and others, have been, or are still, diligently engaged in the practical elaboration of this fascinating but intricate problem, and with whose original or confirmatory researches I shall here and there have occasion to interweave my narrative.

The programme of this narrative consists of three parts. In the first part, I shall enlarge on the genetic relations and chemical constitution of that series of chemical compounds and derivatives which emanate from Prof. Frankland's experiments. In the second part, I shall enlarge on the genetic relations and chemical constitution of that series of chemical compounds and derivatives which emanate from Mr. Wanklyn's experiments. In the third part, I shall dilate on the various species of ketones which are engendered in the destructive distillation of these substances, and briefly explain the nature of the molecular changes which accompany their formation. I shall then endeavour to prove, by a variety of collateral experimental evidence, that the two most conspicuous members of these series —viz., Frankland's ethaceton-carbonic ether and Wanklyn's ethyl-triacetyl—are really constructed upon two distinct chemical types or patterns, and that these constitutional differences are rendered manifest by their general chemical deportment, as well as by the nature of the products of their destructive distillation. I shall, finally, subjoin a synoptical arrangement of chemical formulæ, exhibiting the genetic relations between Frankland's and Wanklyn's series on the one hand, and the lactyl series on the other hand.

PART I.

On the Genetic Relations and Chemical Constitution of that Series of Chemical Compounds and Derivatives which emanate from Professor Frankland's Experiments.

The first question which naturally suggests itself with reference to these experiments is, to identify the particular hydrogenised constituent in the acetic ether molecule which, under the influence of the sodium, is made to furnish the evolved hydrogen gas. Now, in my system of notation* the chemical constitution of acetic ether is expressed by the formula $2H_4C_4; H_2O_2.2H_3C_2; 2C_2O_3$, so that the hydrogen which is set free must proceed either from the ethylen-adjunct of the modified water base, or from the methyl-adjunct of the modified oxalic acid. The chemical deportment and composition of the resulting products and their derivatives incontestably prove that it is the latter adjunct and it alone. Taking this for granted, we can readily understand how the successive displacement of the three methylic hydrogen molecules by a corresponding number of sodium molecules will give rise to three varieties of substituted acetic ethers, which are distinguished by Frankland as sodacetic ether, disodacetic ether, and trisodacetic ether; and it is important to state that Wanklyn has likewise succeeded in obtaining the first-named compound by the action of ethylate of sodium on acetic ether, which shows that the soda has first of all been reduced by one of the methylic hydrogen molecules with production of ethylic alcohol, and that the liberated sodium has afterwards stepped into its place. Wanklyn, however, has thought proper to call his substance, which I believe to be chemically identical with the sodacetic ether of Frankland, by the term acetate of ethylen-sodium, implying thereby that it is not one of the methylic hydrogen molecules, but one of the ethylen-hydrogen molecules which has interchanged places with the sodium. I have searched everywhere, but in vain, for some striking experimental evidence in support of this, in itself, by no means unreasonable supposition; but I flatter myself that the contents of the following pages will convince the reader, and perhaps also Mr. Wanklyn, that his hypothesis cannot be seriously maintained. Besides the three aforesaid varieties, Frankland accomplished to obtain yet another and more complex group of sodium compounds, which involve the co-operation of two acetic ether mole-

* The reader will bear in mind that the various marks of punctuation used in my formulæ are typical symbols of molecular grouping. Thus, a dot connects the base with its acid; a semicolon connects the hydrocarbon adjunct with its principal; an inverted semicolon connects the halogen adjunct (which includes every species of mono- or poly-normal acids, bases, or salts) with its principal; and a colon connects two or more simple hydrocarbons with one another. Observe, also, that in my rational formulæ the non-essential constituents are generally separated from the essential constituents by a horizontal line, and that the empirical formulæ used in my system are exactly the double of the ordinary formulæ. $H_2=2$; $C_2=12$; $O_2=16$.

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cules. The first of these bodies is mentioned in his memoir under the name sodaceton-carbonic ether, and the second under the name disodaceton-carbonic ether. I shall in the sequel endeavour to demonstrate that these two species of compound ethers are formed by the chemical union of sodacetic ether and disodacetic ether respectively with a peculiar kind of alcohol, the hydrocarbon adjunct of which is represented by the condensed carbon molecule $2C_4$, and to which I shall apply the term deacetylic alcohol. This condensed carbon molecule occupies the second place in the series of multivalent carbon molecules pertaining to the first type of my metachemical system. They are all held to be incapable of existing in the free state, but to acquire stability in the form of adjuncts, as, for instance, in combination with the hydrogen nucleus of a water base. It is no doubt true that not a single one of the corresponding alcohols has as yet been obtained in a state of isolation, but their occurrence in combination I believe to be as certain as it is theoretically indispensable. The subjoined list shows the relation of these species of alcohols to each other and to their more or less hydrogenised isologues.

List of Primary Alcohols.

Formethylic or Demethylic.	Methylic.		
$2C_2$; $H_2O_2.H_2O_2$	$2H_2C_2$; $H_2O_2.H_2O_2$		
Deacetylic.	Acetylic or Deethylic.	Ethylic.	
$2C_4$; $H_2O_2.H_2O_2$	$2H_2C_4$; $H_2O_2.H_2O_2$	$2H_4C_4$; $H_2O_2.H_2O_2$	
Deacrylic.	Acrylic or Deallylic.	Allylic or Depropylic.	Propylic.
$2C_6$; $H_2O_2.H_2O_2$	$2H_2C_6$; $H_2O_2.H_2O_2$	$2H_4C_6$; $H_2O_2.H_2O_2$	$2H_6C_6$; $H_2O_2.H_2O_2$
&c.	&c.	&c.	&c.

The generation of the aforesaid deacetylic alcohol out of the elements of the second conspiring acetic ether molecule may be briefly explained as follows:—One of the methylic hydrogen molecules becomes oxidised at the expense of the associated oxalic acid, when the resulting water molecule by combining with the ethylic ether base gives rise to 1 molecule of ethylic alcohol. In the existing conditions, the residual oxyacetylen, $2H_2C_2$; $2C_2O_2$, is then supposed to experience that peculiar kind of isomeric transformation which removes it from the category of genuine acids into the category of genuine alcohols. In this process the carbonic oxide is completely deoxidised by the two hydrogen molecules of the methylen adjunct, while their respective carbon molecules, which are now set free, coalesce under the condensed form, $2C_4$, and are then held to unite as hydrocarbon-adjunct with one of the two newly-formed water molecules, while the other assists in the production of deacetylic alcohol. Finally, this alcohol, by connecting itself as halogen-adjunct with the neighbouring molecule of sodacetic or disodacetic ether, gives rise to Frankland's sodaceton- or disodaceton-carbonic ether. I may here mention that Professor Geuther was the first in preparing the aceton-carbonic ether (his diacetic ether) by treating the former of these sodium compounds with hydrochloric acid. The formula of this ether is therefore—

$$\frac{H_2O_2.\quad 2H_4C_4;H_2O_2.}{2C_4;H_2O_2:2H_2C_4;2C_2O_2},$$

and it is clear that the successful introduction of acids or bases into the alcoholic constituent would furnish strong experimental proof in favour of my mode of reasoning, which endows it with all the attributes of a true biatomic water salt.

Let us, in the next place, turn our attention to that very remarkable class of derivatives which Professor Frankland obtained by subjecting his sodium compounds to the action of iodide of ethyl. All these derivatives have one striking feature in common, which is that they are produced by the successive substitution of 1 molecule of ethyl for 1 molecule of sodium in the methyl-adjunct of the acetic ether. And here it is necessary for me to state that, in formulating the resulting complex hydrocarbon-adjuncts, I have been guided by a peculiar principle, the nature of which it is impossible for me to elucidate here without greatly exceeding the limits of the present communication. For further information I must therefore refer the reader to my paper "On the Chemical Constitution of the Hydrocarbons," which will soon be ready for publication. The derivatives just alluded to may be divided into two sets. The members of the first set are obtained by the action of iodide of ethyl on sodacetic and disodacetic ether respectively, and comprise (1) the ethacetic ether with the formula—

$$\frac{2H_4C_4;H_2O_2.}{2(H_3C_4:HC_2);2C_2O_2},$$

and the diethacetic ether with the formula—

$$\frac{2H_4C_4;H_2O_2.}{2(H_3C_4:H_4C_4:HC_2);2C_2O_2}.$$

The members of the second set are obtained by the action of iodide of ethyl on sodaceton- and disodaceton-carbonic ether respectively, and comprise (1) the ethaceton-carbonic ether (ethdiacetic ether of Geuther), with the formula—

$$\frac{H_2O_2.\quad 2H_4C_4;H_2O_2.}{2C_4;H_2O_2:2(H_3C_4:HC_2);2C_2O_2},$$

and (2) the diethaceton-carbonic ether—

$$\frac{H_2O_2.\quad 2H_4C_4;H_2O_2.}{2C_4;H_2O_2:2(H_3C_4:H_4C_4:HC_2);2C_2O_2}.$$

Reserving my remarks upon these four derivatives for Part III., I shall now request the reader to accompany me to the other extremity of the scale of gaseous pressure, where Mr. Wanklyn had been in the habit of performing his experiments. When this skilful manipulator, in reliance upon the harmonious results of his own carefully conducted experiments, took it upon him to challenge the accuracy of Professor Frankland's statements, it may well be imagined, that not only the illustrious author of these statements, but along with him a number of competent and sympathising judges, were filled with alarm and astonishment at the bold assurance with which this charge was preferred, for it became patent to every one that the imputed error, if really committed, was of a nature to detract from the world-wide reputation of one of our greatest living experimentalists. No wonder, therefore, that scientific men began to watch with keen and anxious eye the further progress of this remarkable case, which is still pending, but which, it is to be hoped, will terminate to the satisfaction of all parties concerned. In the earlier part of this paper I have already had occasion to allude to certain facts having been brought to light which lead to the pleasant conclusion that no blame attaches to either of the two observers, whose respective reports, though more or less contradictory of each other, are perfectly correct in their way, but rather, if that were possible, to the capricious character of the observations themselves. This important point being settled, the whole charge must fall to the ground, and I for one shall rejoice to learn that the two chief actors in this singular contest have formed the noble resolution of resuming this most interesting and instructive problem in friendly communion with one another; and, since we are all labouring for a common cause, let each one of us, according to the measure of his

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abilities, endeavour to share with these gentlemen the honour of paving the road for a more comprehensive and more truly rational system of chemical philosophy. With these prayers and sentiments, sincerely uttered on my part, and re-echoed, I fondly hope, by that chosen band of enlightened and devoted chemists who spend the best portion of their time, their talents, and their treasure in the discovery and propagation of scientific truth, I shall invite the reader to accompany me to the second part.

(To be continued).

ON MEAT AND THE METHODS OF PRESERVING IT.

By H. ENDEMANN, Ph.D.

MEAT is composed of various substances, which, up to the present time, are not yet all known. Their number is being increased every few years by new discoveries, which, however, do not always meet the expectations of over-zealous admirers of Liebig's Extract. Theories, which attribute to newly-discovered substances the life-giving power which has made the extract of meat a medicine, must be confirmed by physiological experiments; whereas, thus far, they have failed entirely to assign a specific function to any of the products of the decomposition of albuminous substances formed in the living organism. I may therefore avoid any omission in the enumeration of the component parts of meat, by grouping all these substances under the general heading, "Products of the Decomposition of Albumen."

Meat consists of fibrin and albumen (about 25 per cent) and the rest of the solid constituents (about 2½ per cent in the average) is composed of the products of decomposition of albumen and of alkaline salts. The albuminous substances, fibrin and albumen, represent the nourishing properties of meat, while the salts, possessing likewise nourishing qualities, are important for the promotion of digestion. About twenty years have elapsed since Liebig made his first investigations on the constituents of meat. It was then also that he advanced his views concerning the nourishing properties of the extract of meat, and we find in the *Chemische Briefe*, published shortly afterwards, his ideas set forth so clearly that the unprofessional reader may understand and duly appreciate them.

I feel confident that the value of this extract was and is, even now, over-estimated. Liebig himself abandoned the idea that the organic constituents of the extract were the agents of its beneficial effects, and experiments, made some years ago in England, show plainly that the ashes of the extract are capable of producing the same effects as the extract itself. Even now, however, after the explosion of the theories, that albuminous substances might be built up again from the products of their decomposition, experiments are constantly made to find organic constituents capable of producing the effects of the extract itself, as is evidenced by the recent discovery of carnine, the physiological effect of which is, according to the experiments, more than doubtful. Liebig states that "the extract, which is produced by extracting meat by cold water, is the nourishment for the muscle;" but the meat liquor is not only the agent of transmitting the nourishment from the blood to the muscles, it also contains the waste products formed during the action of the muscles. Liebig in preparing his extract, however, excludes the real nourishment by coagulating it, and carefully collects the products of decomposition for the good of humanity.

But, if the alkalies alone constitute the value of this extract, is there not a waste of most valuable material? The interest of the manufacturer will not be disputed, but why does the intelligent consumer pay dollars for that which he might buy for a few cents?

The fact is, that the public is as yet in the dark; the published experiments are known in most cases only to scientific men and command attention, while the want of support by illustrious names makes them soon forgotten. For the proper utilisation of meat, the albuminous as well as the extractive portion must be preserved, for the former not only re-supplies the body with albumen, which had become decomposed by the action of the muscles, but serves also as a combustible, while the extractive portion is necessary for a proper digestion. Let us see how these requirements are fulfilled by the methods in vogue for the utilisation and preservation of meat.

When meat is salted, it is treated with an excess of salts (common salt and saltpetre), which absorb the water, forming a concentrated solution, which contains besides these salts much of the extractive portion of the meat. This solution is removed before using the meat, and the latter is even soaked in fresh water for some time, to remove the excess of salts. It is evident that such meat is very poor in extractive salts, and for this reason very difficult to digest.

The action of smoke depends upon the carbolic or cresylic acid contained therein. These substances coagulate the albumen and fibrin, and thus prevent decomposition. Smoked meat is therefore not so easily digested as raw beef, since not only the gastric juice must remove the carbolic acid before digestion is possible, but the albumen and fibrin, being already coagulated, will resist more strongly the dissolving action of the juice. The conditions will be even more unfavourable for a proper digestion, if the salting and smoking process have been combined.

One of the most rational processes of modern invention is the preservation of meat by enclosing it in air-tight cans. This process would undoubtedly give full satisfaction, if it were not for mechanical difficulties, which cannot as yet be surmounted. If properly carried out, however, it is the best process known, because it furnishes the meat in its pure and unadulterated state, the great agent of decomposition, atmospheric air, being excluded.

When we come to consider the different agents of decomposition, we find that they are, first the atmospheric air with its myriad germs and spores, and secondly water. No decomposition is possible without the latter, and I propose therefore the following method of preservation. The meat, after having been cut in slices, should be dried in a hot-air chamber, at a temperature below 140° F. If the apparatus is well constructed, the drying may be completed within three hours, if filtered air be drawn rapidly through the chamber.

In this operation the meat becomes quite hard, and can easily be ground in a mill. It is then in the condition which is best adapted for use. The fibrin and albumen not being coagulated, are able to take up water and the fibres expand into their natural state.

The powder is of a slight brownish yellow colour, has a trifling odour of roast meat, and keeps exceedingly well. This proves that the salts contained in the meat are entirely sufficient for its preservation, if the quantity of water keeping them in solution is greatly diminished by evaporation.

Its use is easily understood. For beef soup—two ounces of the powder are boiled for a few minutes with one pint of water and the other usual ingredients. The soup thus prepared will be stronger than that prepared from half a pound of fresh meat, for a solid piece, even after long boiling, will never permit as thorough extracting as the meat powder.

For solid roast meat dishes, the addition of one egg to a pound of meat powder, together with the requisite quantity of water, suffices to re-unite the separated fibres by means of the coagulating egg-albumen.

The fact that the albumen and fibrin are not coagulated makes it a valuable medicine for consumptives, and in all cases of debility where good nourishment is requisite. It is even more easily digested than raw meat, for the reason, that, if it is taken with cold or lukewarm water, the

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process of swelling will take place in the stomach, where, being surrounded by gastric juice, the latter is absorbed.

This I have tested by actual experiment. Corresponding quantities of raw meat and meat powder were digested in glass flasks, under the influence of equal quantities of diluted muriatic acid and pepsine at a temperature of about 110° F. While the contents of the vessel containing the meat powder, after six hours treatment, represented a uniform, though not quite clear fluid, the vessel containing the raw beef contained yet pieces of the undigested material. A dog was fed for eight days with a daily ration of 5 ounces of meat powder, corresponding to about 1 pound of fresh meat. The average weight of the discharges from the rectum was about one-fourth ounce daily (dried at 200° F.), the maximum being 8·5 grms., the minimum 5·2 grms. Microscopical examination did not show even traces of undigested meat fibre. The only part of the meat found undigested were the relics of the sinews. Pieces of wood, cork, paper, and threads of the carpets formed, besides the mucous membranes and constituents of the bile, the solid part of the excrements. The dog, who had formerly been fed on mixed food, grew very lively during this treatment. His weight at the end of the treatment was 12¼ pounds.

As no apparatus in which the temperature could be regulated during the drying of the meat existed, I have been obliged to construct one according to my own ideas.

This apparatus is so constructed, that the air is sucked through it by an exhauster moved by steam-power. Two valves, one for hot air, the other for cold air, the air being filtered in both cases through cotton, and both acting under the equal outside pressure, supply the apparatus with pure dry air of a certain temperature, which is regulated by the aid of a thermometer. An apparatus of this kind is in operation at my laboratory. .

The drying room of this apparatus measures 27 cubic feet. The air is heated by steam-pipes carrying 60 lbs. pressure, and having 27 square feet heating surface. The exhauster is an inverted quadruple Fan blower of the Rahway Manufacturing Company, of Rahway, N. J., and removes by 420 revolutions 25 cubic feet of air per minute.

By increasing the heating surface and using a larger exhauster, the apparatus may be made more effective yet, so that 100 lbs. of beef can be easily dried within three or four hours.—*American Chemist.*

ON SOME REACTIONS OF SOLUBLE GLASS.

By F. A. FLUCKIGER.

Vogel has recently demonstrated that in mixing concentrated solutions of silicate of potassa, and borate of potassa, which contain an excess of caustic potassa, silicic acid is separated. Several investigations have directed the writer to the general law, that *the salts of potassium, sodium, lithium, and ammonium most readily soluble in water, have especially the power of separating silicic acid from concentrated solutions of soluble glass.* For instance, the following salts possess this property in cold saturated aqueous solutions: of the ammonium salts, the chloride, bromide, sulphide, phosphate, molybdate, nitrate, acetate; of the sodium salts, the chloride, nitrate, nitrite, arseniate; and among the potassium compounds, the iodide, sulphide, sulphocyanide, tartrate, and acetate.

Though most of these salts, by slight dilution, quickly lose this property of separating silicic acid, several ammonium salts retain it to a considerable degree. If, for instance, one mixes a solution of silicate of soda of sp. gr. 1·392, with 29 parts of water, and adds a few drops of a sal-ammoniac solution (1:8 of water), there results, with gentle warming, a separation of silicic acid, though here hardly 2 per cent of the silicate is in the solution. With only ½ per cent of silicate present, chloride of ammonium will hardly cause, after some time, a slight cloudiness, while both sulphocyanide and nitrate of ammonia will immediately precipitate silicic acid in it.

Cold saturated solutions of bromide of potassium or chloride of potassium do not decompose the soluble glass solution referred to, at ordinary temperatures, but do so readily when warm. Sulphate of soda, also, does not act when warm, if cold water has been saturated by the crystallised salt (Glauber's salt); but if the Glauber salt is dissolved in so little hot water that one part of anhydrous sulphate exists in two parts of water, the silicate solution brought to the same temperature will be precipitated by the sulphate of soda.

The relation of the nitrate of soda to the soluble glass solution tested by the writer is worthy of note. With a sp. gr. of 1·392, this left behind after evaporation and ignition 62·8 per cent residue, which, beside the silicate, contained small quantities of chloride of sodium and sulphate of soda. This solution contained so small an excess of alkali that the first drops of alcohol, or an acid solution of any kind, gave a precipitate. If now this soluble glass was decomposed with a solution of nitrate of soda in one part of water, silicic acid separated. If, however, one added nitrate of soda to two parts of water, and mixed equal parts of this solution with the soluble glass, no precipitated resulted. If, however, the mixture was warmed up to 54° C. the silicic acid separated in gelatinous form and the mixture almost entirely solidified. If the experiment was conducted in a flask, and the flask was then suddenly brought back to the ordinary temperature, or cooled down to 0° the separated gelatinous precipitate re-dissolved as quickly. This experiment one can repeat at pleasure.

Caustic ammonia, sp. gr. 0·921, with a solution of soluble glass, sp. gr. 1·392, gives a copious precipitate of gelatinous silica. If the flask is closed and warmed, the precipitate soon re-dissolves. Only this all depends upon the proportions of the mixture. In ten parts of the silicate solution, one part of ammonia causes no change. If one increases the amount of alkali to two parts, the greater part of the silica is precipitated. If the mixture is warmed in a closed flask to 90° C., re-solution of the precipitate soon takes place. After cooling, the gelatinous silica again forms. If one mixes 6 to 8 parts of the soluble glass with 1 part of ammonia (both solutions having the degree of concentration above mentioned) in a closed flask, at about 30° C., a quite clear liquid is obtained, which, however, at a moderate temperature, very soon separates into two layers of nearly equal volume. The upper layer was slightly yellowish, of sp. gr. 1·064, and left on evaporation and ignition not over 9 to 10 per cent residue. When this was repeatedly treated with dilute nitric acid, hydrochloric and sulphuric acids were found abundant in the filtrate. The lower layer was syrupy, entirely colourless, and gave 38 to 45 per cent ignited residue, in which there existed notably either no chlorides and sulphates or very slight traces of them. Though the light liquid soon gave off ammonia on warming it, the same alkali was persistently retained by the heavy liquid. If, however, the latter was evaporated to dryness, the purest, most colourless glass remained, which when boiled with caustic potash disengaged ammonia.

A drop of bromine, or a jet of chlorine gas immediately separates silicic acid from a soluble glass solution. Iodine is unable to effect this reaction. But this property is possessed in the highest degree by creosote from boxwood and phenol (carbolic acid). Also pure chloral hydrate, which leaves a silver solution and litmus paper quite unchanged, is in a form to decompose the silicate of soda in concentrated aqueous solutions.

Dilute solution of the white of a hen's egg, and a solution of glue, also precipitate silicic acid. An emulsion of almonds separates no silica. It has long been known that gum arabic also causes the decomposition of soluble glass. The precipitate contains no gum, but after washing consists essentially of silicic acid. Its for-

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mation is, however, affected by the amount of salts that the gum contains. A gum solution decomposed by HCl, and dialysed, after thorough neutralisation with ammonia, gave no precipitate in soluble glass. Sugar, dextrine, glycerine, &c., have no power to separate silicic acid.—*Repertorium der Pharmacie.*

MISCELLANEOUS.

Presentation of an Address to Professor Tuson.—On the 7th ult., the following address was presented to Professor Tuson by the pupils of the Royal Veterinary College, who had attended the course of laboratory instruction in practical chemistry:—"To Richard V. Tuson, Esq., F.C.S., Professor of Chemistry and Materia Medica in the Royal Veterinary College. Sir,—We the undersigned Students of the Royal Veterinary College beg to acknowledge most heartily the efforts you have made to facilitate the acquirement of a practical knowledge of such a difficult subject as chemistry. While our opportunities for studying this important science were confined to those afforded by attendance on lectures only, the facts and principles of this branch of the curriculum were retained in the memory with extreme difficulty, but since we have had the privilege of working with our own hands in the laboratory, we find that we make greater and more rapid progress, and that we can more thoroughly appreciate the value and practical utility of chemistry to every one desirous of following the profession of veterinary medicine on sound and rational principles. We also beg to congratulate you on your being the first to establish a course of laboratory instruction in the oldest and principal veterinary college of this country; to thank you most sincerely for the sacrifice of your valuable time which you have voluntarily and gratuitously made for our benefit and advancement; and to hope that you may long be spared to participate in that in which you have manifested such a deep interest, *videlicet*, the education and elevation of the social status of the veterinary student."—(Here follow the signatures of seventy-seven students).

How to Fasten Rubber to Wood and Metal.—As rubber plates and rings are nowadays used almost exclusively for making connections between steam and other pipes and apparatus, much annoyance is often experienced by the impossibility or imperfection of an air-tight connection. This is obviated entirely by employing a cement which fastens alike well to the rubber and to the metal or wood. Such cement is prepared by a solution of shellac in ammonia. This is best made by soaking pulverised gum shellac in ten times its weight of strong ammonia, when a slimy mass is obtained, which, in three to four weeks will become liquid without the use of hot water. This softens the rubber, and becomes, after volatilisation of the ammonia, hard and impermeable to gases and fluids.

Detection of Starch in Mustard.—The following letter addressed by Dr. Doremus to the New York *Evening Post* has been forwarded to us for publication:—"During my recent illness I was shown an article of your issue of January 17, entitled the 'Testimony of Experts at Fault,' in which I was represented as giving evidence under oath, upon a scientific question, on a basis so trivial that a single experiment demonstrated its error. I venture to respond, for the first time in my professional career, to a personal attack through the public journals. I had been asked to analyse a sample of 'Coleman's Durham Mustard,' which I found to be largely adulterated with flour; turmeric and red pepper being employed to impart colour and pungency to the same. As part of my testimony I stated that mustard seeds contain starch. Other experts, supported by recognised authorities, testified that mustard seeds do not contain starch. My opinion was formed from producing the colour test with iodine in test-tubes and on filtering-paper, from seeing the blue starch granules on glass slides with the microscope, and from precipitating the suboxide of copper from an alkaline solution of the soda-tartrate of copper after the starch had been boiled with diluted hydrochloric acid. I testified that the reason why these experts and other investigators had failed to detect the starch granules was that the mustard seeds contain substances which interfere with the iodine reaction. I had discovered and showed to the court that the sulphocyanides prevent the production of the blue iodide of starch, and will discolour very deep blue solutions of this iodine. As these compounds are found in both varieties of mustard seeds, unless they are removed it is impossible to reveal the existence of starch by the iodine reaction, excepting occasional granules, which may be detected with a powerful microscope, even without this precaution. The freshly-boiled mustard to which your correspondent 'B.' alludes, was employed to demonstrate to the court the presence of the sulphocyanide, by using a persalt of iron, and obtaining the blood-red sulphocyanide of this metal, whereas, the sample of seeds with which I produced the blue iodide of starch on filtering-paper, had been so treated as to remove the compound of sulphur and cyanogen. The pouring of a diluted solution of iodine upon filtering paper was a repetition of an experiment I had made to the court some hours before, without obtaining a blue tint; but the solution, weakened by evaporation of the iodine, yielded the tint in question, even without the mustard seeds, or the turmeric which had been tested for starch in a similar way. It is clearly a *non-sequitur* that, therefore, neither mustard seeds nor turmeric contain starch. I have since found that all filtering paper will yield a more or less distinct blue tint with an extremely diluted solution of iodine. The truthfulness of my position may be determined by any chemist who will subject the mustard seeds to the precautionary steps I have narrated before applying his tests.—I have the honour to remain your obedient servant, R. Ogden Doremus, 70, Union Place."

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, April 8, 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral subjects:—

Second Note on the Crystallisation of Baryta Salts the Acids of which are Derived from the Water in which Corpses have been Soaked in Anatomical Theatres.—Professor E. Chevreul.—The eminent author points out in this paper a peculiar behaviour of certain salts which crystallised spontaneously and very slowly, one of these exhibiting the shape of the crater of a volcano, while the other, seen under the microscope, exhibited an appearance not unlike the *méandres* of the *renaissance* style of architecture. The author will shortly give an account of the nature of four acids found in the water alluded to.

Alteration which the Sulphur-Water of Eaux-Bonnes (in the Pyrénées) Undergoes by a Limited Contact with Air.—L. Martin.—The author calls attention in this paper to the peculiar mode of decomposition which the native mineral water of the locality alluded to undergoes when it is in contact with air in reservoirs; the first change is the rapid conversion of the monosulphide of sodium, present in the water as issuing from the rocks, into bisulphide, with the simultaneous production of silicate of soda; the second alteration is the slow, but progressive, always partial, conversion of the bisulphide into hyposulphite of soda by the fixing of oxygen. The water alluded

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to contains in fresh state 2 equivs. of silica for 1 equiv. of monosulphuret of sodium. The silicate formed by the alteration of the water in reservoirs is a quadrisilicate.

Researches on the Apparent Volatilisation of Selenium and Tellurium and on the Dissociation of their Hydrogen Compounds.—A. Ditte.—The contents of this very lengthy memoir are, notwithstanding the high scientific merits, not suited for useful abstraction.

Reducing Properties of Hydrogen and the Vapours of Phosphorus, and on the Application of the same to the Making of Drawings upon Paper.—B. Renault.—In this paper the author first calls attention to the fact that, when a jet of hydrogen is directed against filtering-paper (Swedish) previously impregnated with any salt of silver, the latter is reduced to the metallic state, while the paper becomes thereby blackened. Instead of hydrogen gas, carbonic acid or nitrogen may be used which has been passed over lumps of phosphorus (which is absorbed and carried in the state of vapour along with these gases in very small quantity; the author found in a litre of carbonic acid gas, at temperatures of 4°, 15°, and 17°, from 0·8 m.grm. to 1·2 m.grms. of phosphorus), and it will then even blacken carbonate of copper. In the next place, this paper is devoted to the detailed description of the manner in which this property of hydrogen and vapour of phosphorus may be applied for the production of writing and other tracings upon paper.

Combination of Binoxide of Chromium and Bichromate of Potassa.—D. Tommasi.—By causing binoxide of nitrogen to act upon a boiling solution of bichromate of potassa in fuming nitric acid, there is formed what the author terms dichromate kalichromic—

$$[(CrO_3)_3(CrO_2)_2K_2O]H_2O,$$

an amorphous brownish-violet coloured powder, devoid of taste and smell; sp. gr. at 14°=2·28; it is completely insoluble in water, alcohol, acetic acid, &c.; heated to above 300°, it fuses, becoming decomposed into sesquioxide of chromium, oxygen, bichromate of potassa, and water; cold nitric acid does not act upon this substance, but, by boiling, some of it is dissolved, and converted into chromic acid; cold and concentrated sulphuric acid has no action on the powder, but, when warm acid is employed, the powder is dissolved, yielding a green-coloured fluid, which, on being neutralised with ammonia, yields neutral chromate of that base; aqueous sulphurous acid dissolves the powder, which, with boiling hydrochloric acid, gives off chlorine; the percentage composition of this body is—Chromium, 46·1; potassa, 16·6; water, 3·1; oxygen, 34·0.

Researches on the Part which Organic Matters in the Soil Play in the Nutrition of Plants.—L. Grandeau.—This essay treats on the functions of organic matter in the soil, and contains an account of some experiments made with large samples of portions of soil known as the black soil of Russia, taken at vertical sections of 3 metres depth at Uladowka, which soil has never been manured and yet produces excellent and abundant crops. The main results of the author's investigation are—(1) That fertile soils contain the nutritive mineral elements in the same shape as these are present in farmyard manure; (2) that the fertility of a soil is intimately connected with its richness in mineral elements and in organic matter soluble in ammonia; (3) that the organic matters are the natural vehicles for mineral elements, which are extracted by them from the soil and offered to the roots of plants in an assimilable shape.

Chemical and Microscopical Analysis of the Meteoric Sand Rain which Fell in Sicilia on March 9, 10, and 11.—O. Silvestri.—This exhaustive memoir contains the results of the researches made on rain-water along with which fell a kind of sand; the water, having been filtered, was found to be colourless and free from smell, but exhibited a saline taste; it was neutral to test-paper; hardness, 17·5 degrees (ordinary rain-water, 1 degree). By long-continued boiling, it gave off 19¼ c.c. of gas, consisting of—Nitrogen, 83·959 per cent; oxygen, 13·070; CO_2, 2·971. On being evaporated to dryness, this water was found to contain, in 1000 parts—Bicarbonates of lime, 0·129; of magnesia, 0·035; of iron, traces; sulphate of lime, 0·041; chloride of potassium, traces; sulphate of soda, 0·009; chloride of sodium, trace; organic matter, 0·063. The sand, very finely pulverised and dust-like, has a sp. gr.=2·5258, and contains, in 100 parts—Clay, 75·08; carbonate of lime, 11·65; organic matter, 13·19.

Researches on the Chemical Composition of Chinese Green (Lokao).—S. Cloez and E. Guignet.—After briefly referring to the history of the discovery of lokao, and the investigations of D. Kœchlin, Persoz, sen., Michel, Charvin, and others, the authors treat on the substance alluded to, which they say is a genuine lake colour. The sample operated upon by them was found to contain 9·4 per cent of water and 26·2 per cent of ash. The action of water upon lokao, insoluble in that fluid, does not present any great interest; by the action of alkalies (carbonated), the authors have extracted from the lake a blue-coloured material, which they term lokaine. Ammoniacal lokaine, $C_{56}H_{22}O_{22},NH_4O$, is a true salt, the pure lokaine being a weak acid; by the action of dilute sulphuric acid (1 of acid to 20 of water) upon ammoniacal lokaine, there is formed lokaetine, $C_{18}H_{12}O_{10}$, a substance almost insoluble in water, but which becomes violet-coloured by the smallest trace of an alkali. With nitric acid, lokaetine yields, in addition to oxalic acid, a yellow colouring matter, soluble in alcohol and ether, but this body is not picric acid, from which it differs completely. Strong sulphuric acid dissolves lokaetine in the cold, and water precipitates from this solution a brownish coloured matter, which yields with weak alkalies a deep green-coloured substance, soluble in alcohol; the formula of this body is $C_{18}H_8O_8$.

We regret to learn, from a short communication in this number, the death of the celebrated German *savant* Dr. Hugo von Mohl, a well- and deservedly-known botanist, who died at Tübingen (Würtemberg) on April 1.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, February 22, 1872.

Horn and Tortoiseshell.—C. Mène.—A complete, yet succinct, account of the various mechanical and mechanico-chemical operations by means of which horn and tortoiseshell are converted into various articles made of these substances.

Use of Permanganate of Potassa for the Quantitative Estimation of Sulphurous Acid and Sulphites.—Dr. Hamel.—The author uses a titrated solution of permanganate of potassa acidulated with hydrochloric acid for the purpose of quantitatively estimating sulphites, or rather the sulphurous acid, present in these salts; and as regards free sulphurous acid in solution, it is first neutralised with a solution of carbonate of soda. The moment the violet colour of the permanganate appears, the reaction is finished, and the calculation made according to the formula—

$$Mn_2O_7KO+5SO_2=KO,9MnO+5SO_3.$$

The permanganate solution is titrated according to Hempel's plan with oxalic acid.

Bichromate of Lime as a Substitute for Animal Charcoal in the Sugar Industry.—C. Mène.—It appears that there has been lately imported into Boston, U.S., a large parcel of West Indian raw sugar, which has been treated with bichromate of lime (method not described), and is found very superior to raw sugar made with animal charcoal, while a great saving in expense is also made.

Process for Uniting Caoutchouc to Wood and Metals.—C. Mène.—The author says that a solution of shellac in liquid ammonia is a suitable glue for fastening caoutchouc to wood and metals.

Coating Metals with Nickel by the Moist Way.—C. Mène.—Wrought- and cast-iron, steel, copper, brass, zinc, and lead can be so coated by putting these metals, or objects made of them, in a boiling neutral solution of chloride of zinc, to which a salt of nickel is added, and also zinc, in granulated state or sheet. If the solution be acid the coating will be dull. When, instead of a salt of nickel, one of cobalt be used, a coating of that metal may be obtained.

Method of Dyeing Veneer Wood.—C. Mène.—The wood to be dyed is first steeped for twenty-four hours in a solution of caustic soda, and boiled with it for half an hour. It is then washed, to remove all the alkali, and then (the wood having become as soft as leather and equally elastic, as well as capable of absorbing dye-stuffs) immersed for twenty-four hours, first into a decoction of logwood, and next, after having been superficially dried, into a boiling solution of sulphate of iron (1 part of the salt to 3 of water). When the wood is desired to be yellow-dyed, it is immersed into a solution of picric acid (1 part to 60 of water), to which enough ammonia is added to cause the fluid to smell of it. Wood treated as mentioned with soda may be also dyed with coralline. The dyes are fast, stand varnishing, and thoroughly penetrate through the whole of the wood, which, after drying, may be sawn and veneered.

Animal Charcoal as Antidote against Phosphorus.—Drs. Eulenberg and Wohl.—Based upon experiments very successfully made with animals, the authors propose the use of animal charcoal, made up into pills with gum adraganth, as a very efficient antidote against the bad effects of phosphorus in the lucifer match manufactories; and they prefer the substance alluded to above oil of turpentine, which, though an effectual antidote against phosphorus, causes, in many instances, very severe headaches when internally taken.

Industrial Manufacture of Trichloracetic Acid from Hydrate of Chloral.—C. Mène.—Hydrate of chloral is mixed with its own weight of strong fuming nitric acid, and exposed for three or four days to direct sunlight. The mixture is next distilled; and as soon as the thermometer plunged in the liquid marks 195°, that temperature is kept up, the distillate being trichloracetic acid. This reaction takes place according to the following formula:—

$$2NO_5+C_4Cl_3O_3.HO=2NO_4+\underbrace{C_4Cl_3O_3H}_{\text{Trichloracetic acid.}}$$

The acid just named resembles acetic acid to some extent, and is now used in medicine for cauterising warts, corns, and other excrescences. When trichloracetic acid is boiled along with an excess of ammonia, chloroform and carbonate of ammonia are formed.

Preparation of Suboxide (Red Oxide) of Copper Suitable for Colouring Glass.—Dr. Bœttger.—Heat together in a porcelain basin 300 grms. of sulphate of copper; 450 grms. of sal seignette, tartrate of potassa, and soda; 600 grms. of cane sugar; and 3600 grms. of water. When the solids are dissolved, add 450 grms. of caustic soda, and boil, stirring the liquid occasionally and replacing the water which evaporates. After about one hour's boiling the liquid will have become colourless, and there will be deposited about 80 grms. of the red oxide, which is washed by decantation and next dried at a gentle heat.

February 29, 1872.

Continuation and End of the Lecture on the Services which Chemistry has Rendered to Agriculture.—Dr. Barral.

Gas-Furnace for Smelting Metals.—MM. Perrot and Wiessegg.—The description, illustrated by a woodcut, of a very ingeniously contrived gas-furnace capable of producing very high temperatures, and of very moderate cost—viz., £2 15s.

Estimation of Ammoniacal Salts.—Dr. Rabuteau.—The author's mode of operation is based upon the decomposition of ammoniacal salts and other nitrogen-containing substances by bleaching-powder (hypochlorite of lime), nitrogen gas being set free and collected. The mode of operation is as follows:—A solution of bleaching-powder in water is first treated with a solution of carbonate of soda (2 parts of

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the latter for 1 part of the former, or 100 grms. of bleaching-powder and 200 grms. of carbonate of soda upon 2 litres of fluid); 200 c.c. of the rather dilute solution of the ammoniacal salt to be tested are taken and poured into a flask; there being next added to the saline solution an excess of the clear hypochlorite of soda liquor. The flask, having been provided with a cork in which a gas delivery-tube is fitted, is next heated, and the nitrogen given off collected in a graduated tube and measured with the required and well-known precautions. Care should be taken to render the decomposition of the ammoniacal salt complete by using a relatively small quantity of the salt in proportion to the hypochlorite solution.

New Colouring Matter from Aniline.—C. Mène.—Two parts of nitrite of aniline and 1 part of arsenic acid are heated together for five minutes to from 80° to 120°; the contents of the vessel in which this operation takes place are poured into boiling-water, and the fluid neutralised with lime. The liquid, which turns a beautifully red colour, is filtered through flannel, and the filtrate is next added to chloride of sodium in the proportion of five times the quantity of the nitrite of aniline used. The result is the precipitation of the new colouring matter, which is named saffranine, collected on a filter, and next submitted to pressure to remove water. Saffranine is used instead of safflower for dyeing wool and silk.

Newly-Contrived System for Concentrating Sulphuric Acid.—M. de Hemptinne.—In the year 1854, Dr. Kuhlmann suggested that sulphuric acid might be, perhaps, concentrated in vacuum pans, since lead is not perceptibly acted upon by that acid, even when concentrated at a temperature not exceeding 200°. The author, manufacturing chemist at Molenbeeck, St. Jean, near Brussels, is stated to have solved the practical difficulties which beset the use of leaden vacuum pans (the atmospheric pressure on a square metre of surface of vessels in which a vacuum is made is equal to a dead weight of 10,000 kilos., and lead, as is well known, is a soft, yielding metal), by constructing a vacuum pan provided with glass and glazed fire-clay stays, which are not acted upon by the acid, and thus capable of withstanding the external atmospheric pressure, while the concentrated acid (boiling-point in air, 325°) may be boiled at from 190° to 195° under reduced pressure.

March 7, 1872.

Use of Amorphous Silica as a Fixing Agent (Mordant) for Dyes and Pigments.—M. Reimann.—It appears that when fabrics made of cotton, flax, or other vegetable and animal fibres, are first treated with a silicate of soda solution, and next with a weak acid solution, the fabrics so prepared are suitably mordanted for taking up many dyes and pigments, especially the so-called tar colours.

Newly-Contrived Smoke-Preventing Chimney Top.—M. Chalès.—The arrangement, illustrated by woodcuts and fully described, appears to be an excellent plan of preventing smoky chimneys in private houses.

Wood Varnish for Furniture and other Wooden Objects.—C. Mène.—To 1 kilo. of very fluid copal varnish are added 15·62 grms. of best boiled linseed oil, and the mixture heated for the purpose of making the incorporation complete. The wood to be varnished is first coated with a solution of gelatine, to which either some precipitated chalk or some red ochre is added, according to the nature of the wood (light or dark-coloured naturally). When the coat of varnish is dry the varnished article is rubbed with a solution of wax in ether.

Sulphur as a Lubricating Material.—J. Ménard.—To 100 kilos. of good colza oil the author adds 5 kilos. of sulphur, and heats this mixture to from 130° to 140° until all the sulphur is dissolved. It is said that, being a bad conductor of heat, sulphur has the service here of preventing the heat caused by the friction of machinery to be carried over upon the oil, which therefore can serve for a longer period than usual as a lubricating medium.

La Revue Scientifique de la France et de l'Etranger, April 13, 1872.

This number contains the following essay:—

What is Force?—Dr. P. de Saint-Robert.

We also meet here with a brief account of the proceedings of the meeting of the Chemical Society of Paris held on April 5, from which we quote the following:—

New Product of the Condensation of Aldehyde.—Dr. Wurtz.—When a mixture of water, aldehyde, and hydrochloric acid, is left to itself for a fortnight, next saturated with carbonate of soda, then well shaken up with ether, there is obtained, by the evaporation of the latter, a viscous thick mass, which is purified by distillation *in vacuo*, when the substance comes over at between 95° and 105°; this body is so viscous that the vessel in which it is contained may be inverted without the substance flowing out. This body has a high refractive power, is soluble in water, alcohol, and ether, and its simplest formula is $C_4H_8O_2$. The further investigation of this compound proves it to act as an aldehyde as well as an alcohol; it reduces nitrate of silver, forming a metallic mirror on glass, and combines with acetic acid, yielding a liquid acetate, which may be distilled *in vacuo* between 90° and 95°, and is composed of $C_4H_7O_2(C_2H_3O)$. The constitutional formula of this body is—

$$\left.\begin{matrix} CH(CH_3) \\ | \\ CH_2-C \end{matrix}\right\} \begin{matrix} OH \\ =O \\ -H \end{matrix}$$

By nascent hydrogen, it is probably converted into butyl-glycol, $C_4H_{10}O_2$. When it is tried to distil this body at the ordinary pressure, it is dissociated, yielding water and crotonic aldehyde, C_4H_6O.

Synthesis of Orcin.—A. Henniger and G. Vogt.—When chlorated toluen, C_7H_7Cl, is dissolved in sulphuric acid, there is formed a sulpho-conjugated acid, the potassa salt of which, termed by the authors chloro-cresyl-sulphite of potassa, $C_7H_6ClSO_3K$, yields, when fused with caustic potassa, orcin, salicylic acid, and cresylol; the two latter substances are, however, due to a secondary reaction. The formation of orcin, $C_7H_8O_2$, is elucidated by the following formula:—
$C_7H_6ClSO_3K + 2KHO = C_7H_8O_2 + KCl + SO_3K_2$. The orcin thus formed has been ascertained to be in every respect identical to that obtained from lichens, even as regards the coloured reactions.

Solvent for Oxides of Copper and Chromium.—M. Prudhomme.—In the presence of oxide of chromium, oxide of copper is stated by the author to be soluble in potassa and soda solutions, while oxide of chromium, by itself insoluble in ammonia, dissolves in that fluid when oxide of copper is present in it.

Silicate of Ethyl.—Dr. Friedel.—The author has succeeded in obtaining silicate of ethyl by heating, for some hours in a sealed tube, iodide of silicium with an excess of ether to 100°. On opening the tube, after cooling and distilling the contents, ordinary ether is volatilised, along with iodide of ethyl first, and at 160° silicate of ethyl comes over; the reaction is elucidated by the following formula:—

$$\underbrace{SiI}_{\text{Iodide of silicium.}} + \underbrace{8(C_2H_5)_2O}_{\text{Ether.}} = \underbrace{Si(OC_2H_5)_4}_{\text{Silicate of ethyl.}} + \underbrace{4(C_2H_5I)}_{\text{Iodide of ethyl.}}$$

This number also contains an interesting and noteworthy account of the meetings of the Geological Society of Paris held on April 4 and 8, and a well-written biography of the late well-known *savant* P. A. E. Laugier, just deceased at Paris, where he was highly appreciated as an eminent astronomer and member of the Bureau des Longitudes.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, March, 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Report on Two Essays of Dr. Sacc Relating to the Action of Nitric Acid and Caustic Soda upon Drying and Non-Drying Oils.—Dr. Barral.—The main contents of this paper appeared in our pages about two years ago; the reactions are of practical value for the purpose of distinguishing between different kinds of oils.

Description of a Furnace for Treating Iron Ores According to Ponsard's System.—M. Grüner.—This paper is accompanied by a series of engravings. The object of this furnace and mode of smelting ores is to convert the same into wrought-iron or steel in one operation,

Report on Objects Made of Iron and Cement by J. Monier.—M. Paliard.—This paper contains an account of a method of constructing various objects of a framework of iron, which gives support to cement; not only ornamental, but also useful, objects are made by this method.

Les Mondes, April 11, 1872.

Meeting of the Delegates of the Learned Societies, and Report of the Proceedings.—Dr. Blanchard.—A valuable review of the scientific researches made in France in the course of the last year: to several scientific men, gold and silver medals have been awarded, either for prize essays or for peculiar scientific researches. Incidentally, we are here reminded that ozone was first noticed, and some of its properties described, by Dr. van Marum, one of the directors of Teyler's institution at Haarlem, in 1785; the name ozone is, however, due to Schœnbein's researches.

Programme of the Physical Researches and Observations about to be Made in the Mont Cenis Tunnel by the Rev. A. Secchi, S.J., the Engineer Diamilla-Müller, and the Rev. Father Denza, S.J.—Pendulum observations; meteorological observations, inclusive of magnetic, and observations on the temperature of the rocks, will be made; very accurately made instruments will be used. Our readers are probably aware that there exist in the tunnel spaces, termed lateral chambers, which will serve for the purposes alluded to.

MEETINGS FOR THE WEEK.

MONDAY, May 6th.—Medical, 8.
—— London Institution, 4. Prof. Bentley, "On Elementary Botany."
—— Royal Institution, 2. General Monthly Meeting.
TUESDAY, 7th.—Civil Engineers, 8.
—— Royal Institution, 3. E. B. Tylor, F.R.S., "On the Development of Belief and Custom amongst the Lower Races of Mankind."
—— Zoological, 9.
WEDNESDAY, 8th.—Society of Arts, 8.
Geological, 8.
THURSDAY, 9th.—London Institution, 7.30. Lecture.
Royal Institution, 3. Dr. Tyndall, LL.D., F.R.S., "On Heat and Light."
FRIDAY, 10th.—Royal Institution, 9. Nevil Story Maskelyne, Esq., F.R.S., "On Meteoric Stones."
—— Astronomical, 8.
—— Quekett Microscopical Club, 8.
SATURDAY, 11th.—Royal Institution, 3. R. A. Proctor, Esq., B.A., "On Star-Depths."

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NOTES AND QUERIES.

Grey and Brown Acetate of Lime of Commercial Qualities.—Will any reader kindly inform me how to estimate the quantity of acetic acid in the above articles in a ready manner, or refer me to any treatise from which I could learn a simple process for this purpose, either by volumetric analysis or precipitation?—S. S.

TO CORRESPONDENTS.

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T. R. Ogilvie.—This correspondent is thanked for his communication; we are glad to comply with his request.

T. B. Blunt and J. Mayer.—Received with thanks.

M. H. Hills.—The last edition of Plattner's work is the best.

Chemicus.—You should advertise for a copy.

A Constant Subscriber.—The English edition of Wagner's "Technology." It will be published in a few days.

C. P.—We are not aware of any chemical process which will restore the brilliancy.

E. Jones.—The last edition of Sutton's "Volumetric Analysis."

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THE CHEMICAL NEWS.

Vol. XXV. No. 650.

REPORT ON THE WORKING OF THE A B C PROCESS OF UTILISING SEWAGE AT CROSSNESS.*

By GUSTAV BISCHOF,
Professor of Technical Chemistry in the Andersonian University, Glasgow.

The author describes an ingenious improved contrivance for mixing the sewage and A B C mixtures. The sewage, in running through the channel leading to the tanks, sets a water-wheel in motion, which again imparts motion to an ordinary governor, such as is commonly used for steam-engines. The governor is in connection with a valve, through which the A B C mixture is admitted to the sewage channel. The quicker the motion imparted to and by the water-wheel, the wider is the valve opened by the action of the governor, and thus the proper admixture is automatically regulated. The mixed sewage and A B C mixture is then run into a series of six reservoirs or settling tanks, each 50 feet long, 20 feet wide, and about 7 feet deep. The mud having settled down, the effluent is drawn off by pipes, while the mud, after being passed into tanks, dried, and ground, is ready for the market.

The area of land occupied by the Crossness works is about 250 feet by 150 feet, or rather more than three-quarters of an acre.

The author observed during his visit of some days to Crossness, that the treatment of sewage by the A B C process causes no offensive odour. The effluent is perfectly clear and devoid of smell. The drying of the mud was not in operation during the author's stay, but he was informed that no offensive gases were evolved.

The Crossness Works are styled "Model Works" for the reason that the various operations are carried on in open apparatus to enable those interested in the subject to satisfy themselves on all essential points of the process. In ordinary cases the operations are carried on underground, and the author thinks the process may be worked close to and even in large towns and cities without any inconvenience or injury to the inhabitants, thus saving the expense of conveying the sewage to a great distance.

In reply to the question whether the effluent be sufficiently pure to be discharged into rivers, the author gives the results of an analysis of the Leeds effluent recently made by Mr. Crookes, who found in 100,000 parts of the sewage—

	Total Solid Impurities.	Organic Carbon.	Organic Nitrogen.	NH_3.	Total Contained N.	Cl.	Suspended Matter.		
							Mineral.	Organic.	Total.
(1).	111·40	0·77	1·16	2·31	3·06	14·4	1·25	0·59	1·84
(2).†	—	2·00	0·30	—	—	—	3·00	—	—

The maximum amount of organic carbon allowed by the Rivers' Commissioners is 2·00 and 0·30 of organic nitrogen, so that, according to Mr. Crookes's analysis, the organic nitrogen is not sufficiently removed. The author proposes to effect this by irrigating land with the effluent which, being free from smell, can be carried at little cost in open trenches to any distance. But where irrigation is impracticable, it is proposed to filter the effluent. Dursley earth has been proposed as a filtering medium by Dr. Frankland. A qualitative analysis by the author proved this earth to be almost completely soluble in hydrochloric acid. The solution contained proto- and peroxide of iron, a little alumina, much lime, a little magnesia, a moderate proportion of the alkalies, much carbonic acid, silica, 0·15 per cent of phosphoric acid, and traces of sulphuric acid.

Mr. Stanford's kelp-ash has been also suggested as a filtering medium, while Dr. Spencer proposes magnetic oxide of iron. The author proposes spongy iron. An analysis of a sample of Mr. Spencer's carburetted iron proved that it did not contain a trace of metallic iron. The purifying action of magnetic oxide of iron appears to be mainly due to the ferrous oxide present. Mr. Spencer attributes this action to its physical property of attracting atmospheric oxygen to its surface, and then transferring it to organic substances, which thus become oxidised.

Spongy iron, on the other hand, is metallic iron reduced from an oxide without fusion. The author refers to an experiment tried, and analytically controlled, by Professor Voelcker, which shows that by means of this iron, sewage may become, using Dr. Voelcker's own words, "purer than many drinking waters." It decolourises many organic substances to such an extent that beer, for instance, may, by slow filtration, be completely decolourised. Its purifying action is much more complicated than the action assigned by Mr. Spencer to the magnetic oxide. Spongy iron has the property of decomposing water, probably due to the galvanic current produced by the contact of iron and carbon. The oxygen thus produced may have a powerful oxidising action on organic matter.

During filtration some of the iron is dissolved, probably, by the action of the carbonic acid contained in water. As the purification of water progresses some five or six hours after passing through spongy iron, whilst the purification is stopped at once, and rendered much more incomplete if the solution be boiled directly after its filtration through spongy iron, the author concludes that organic matter may reduce the iron dissolved as above whilst in a low state of oxidation to a still lower oxide, which, by the action of the atmospheric oxygen of the water, or by the oxygen above referred to, is re-converted into the higher state of oxidation, the iron thus acting as the carrier of oxygen to organic matter. These conclusions are corroborated by the author's observation, that the purifying action is also greatly diminished by the addition of a minute quantity of sodium carbonate, which prevents the solution of the iron.

The dissolved iron, after peroxidation, probably has the property of mechanically carrying down with it the impurities of water.

How long the spongy iron will remain active has yet to be ascertained by practical trials. It can be revived and purified at little cost by heating in a furnace with the addition of carbonaceous matter.

Supposing even none of these proposals for filtration give satisfactory results, the discharge of an effluent of similar composition to that analysed by Mr. Crookes, into the Thames or other rivers, instead of the raw sewage as is now done, would, in the author's opinion, be a great and material improvement.

The author proceeds to consider how far the manurial value of the so-called native guano represents the manurial value of sewage, and whether the demand is likely to render the process a commercial success.

In the analysis of the effluent there is no phosphoric acid; thus all phosphoric acid contained in sewage must have passed into the guano. As far as it is possible to determine, raw sewage contains, in 100,000 parts, some 6·7 parts of ammonia; this figure being the average of the six samples re-

* Abstract of a paper read before the Chemical Section of the Glasgow Philosophical Society.

† Column 2 represents the maximum amount allowed by the Rivers' Commissioners.

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ferred to in the report on the "Treatment and Utilisation of Sewage" of the committee appointed by the British Association. As the effluent contains 2·31 ammonia, about 66 per cent of it may have passed into the guano. It may be remarked that the average of ammonia in the effluent from sewage which has been utilised by irrigation, is stated in the above report equal to 1·5, but as the lowest figure, at Breton Farm, is 0·202, and the highest, at South Farm, 3·436, it is but reasonable to expect a better average result if the conditions which have been found essential in irrigating be universally adopted.

Although chemical analysis does not assign a great manurial value to the native guano, it appears from the above figures that the utilisation of sewage by the A B C process is satisfactory. On the other hand, there is a great waste by the irrigation system, for Mr. Denton states that the same amount of cropping was produced by applying in one instance, from 12,000 to 15,000 tons, and in the other, only 4000 tons of sewage.

The result attainable by the so-called native guano for manurial purposes has already been practically tested. The author refers to more than a hundred highly favourable opinions expressed by farmers after practical trials of the native guano, extended over a period of two years. Some sixteen or eighteen more were unfavourable, but most of these last could be distinctly traced to utter sterility of the soil, or to mismanagement in applying the native guano. It is well known, of course, how easily such opinions are "got up" in reference to the action of drugs on the human system, and so on, but it is not so easy in the case under consideration, where the actual result could be, and was, estimated by weights and measures.

The author replies to the objection that the little value demonstrated by chemical analysis is due chiefly to the A B C mixture, by stating that this does not affect the manurial value of the guano, if the cost is £1 10s. per ton, while the demand at £3 10s. per ton is greater than the supply.

ON THE

IDENTITY OF LIGHT AND RADIANT HEAT.*

By Professor TYNDALL, LL.D., F.R.S.

WHETHER we regard its achievements in the past, or its promise and tendency in the future, all that we know of physical science—every bent and bias which we receive from its pursuit—tends to confirm the dictum of the poet regarding this universe:—

> "All are but parts of one stupendous whole.
> Whose body Nature is."†

If I halt here, and omit the next clause of the couplet, it is not because physical science has arrived at any conclusion hostile to that clause, at all events in its profoundest signification, but simply because what the poet goes on to affirm lies outside the sphere of science. We, as physical students, have to do with "Nature" only, and our view of nature could not be more happily expressed than by the figure employed by the poet. For our vocation, and the delight and discipline that it confers, do not consist in the registration of unrelated facts and phenomena; but in the searching out and discovery of relationship in a system, whose parts we hold to be as closely and definitely related to each other as are the various organs and functions of the living body itself.

It was this spirit of search, this capacity and desire, developed amid natural agencies, to detect the lines of connection between these agencies, that gave for a time such keen interest to the discussion, whether light and heat were essentially different things, or whether a substantial identity subsisted between them. It is not so very many years since that most excellent experimenter and philosophical inquirer, Melloni, isolated from a solar beam a brilliant light, and finding it incompetent to affect his most sensitive thermoscopic apparatus, concluded that light and heat were essentially distinct. But in drawing this conclusion, Melloni forgot that he was implicitly dealing with an instrument of almost infinitely greater delicacy than his thermoscopic apparatus; he forgot that, the human eye, and the consciousness connected with the eye, are capable of being vividly excited by an amount of force which, when translated into heat, might defy all the thermometers in the world to detect it. Melloni himself subsequently modified his conclusion.

It is not so very long since the late Princpal Forbes was eagerly engaged in establishing the important point that radiant heat, like light, is capable of being polarised. Since that time Knoblauch, Foucault, Fizeau, and Seebeck have applied their refined experimental skill to this question of identity; and those excellent investigators De la Provostaye and Desains, pushed the analogy between light and heat so far as to prove that the magnetisation of a ray of light, in Faraday's sense of the term, has its parallel in the magnetisation of a ray of heat.

It was, however, in their private cabinets that these experimenters obtained their results, which were in most cases so small as to require attention on the part of a skilled observer to detect them. But science grows, and our experimental means argument as our knowledge expands. Recent discoveries and improvements will, *I* trust, enable me to make evident to you effects which have been hitherto confined to far more limited circles; some of which, indeed, have only been seen by the observers who first noticed and described them. And if those accidents which often hold sway over lecture experiments of a delicate character should prove favourable, we may be able to push the subject a hair's breadth beyond the limits which observation has hitherto assigned to it.

Heat is presented to us in two aspects: sometimes associated with ordinary matter, through which it creeps by the process of conduction; sometimes not associated with ordinary matter, but, like light, flying through space with immense velocity. In this latter form it is called *radiant heat*. Radiant heat obviously and palpably comes to us from the sun, but here it is entangled with light. Let me, in the first place, endeavour to unravel this entanglement.

When white light is refracted, it is unravelled, and the spectrum is produced. A spectrum of the electric light was thrown upon a screen; and red, green, and black ribbons about an inch wide were successively moved along it. The red placed in the red light appeared a brilliant red; when moved into the green it became black. In like manner the green ribbon moved from the green, where it shone vividly green, into the red, became an intense black. The black ribbon was black in every part of the spectrum.

Now the red ribbon is not heated in red, and the green is not heated in green; but red is heated in green, and green in red. We have heating only where we have absorption; and the heat generated is the equivalent of the light absorbed. Black absorbs all the rays of light, hence, indeed, its blackness; and if it could speak, it might tell us the warmth of every colour. But warmth exists outside the colours. Beyond the red, where nothing is seen, the force acting on the retina is far greater than when the eye is plunged in the red. The objective here is entirely out of proportion to the subjective.

The existence of this heat was thus proved. All the colours but the red were cut off by a red glass, and with a diaphragm having a circular opening, a well-defined red circle was produced. This was refracted by a prism, still remaining a circle. A thermo-pile with its face towards

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* Read before the Royal Institution of Great Britain, February 2, 1872.

† "All are but parts of one stupendous whole,
Whose body Nature is, and God the soul."
POPE'S "Essay on Man," Epistle I., line 267.

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the lamp was then caused to approach the path of the beam. It would have been seen by its shadow on the screen if the light had been at all invaded; but with a considerable interval between the pile and the light, a large deflection of the galvanometer testified to the presence of heat beyond the luminous circle. An opaque solution* was substituted for the red glass. A circle remained, but it was an invisible circle of radiant heat instead of a circle of light, and the needle of the galvanometer did not fall, though the visible image had vanished.

Thus, as regards refraction, we have radiant heat behaving like light. And now for reflexion. A horizontal beam of light was reflected upwards by a plane mirror, and when the light was cut off by the introduction of the opaque cell, a powerful beam of reflected heat was proved still to remain. The luminous beam was then *totally reflected* by a prism to a horizontal direction; the light was again cut off, and a powerful deflection of the galvanometer needle was obtained by the residual heat-beam. Thus, in respect to common and total reflexion the behaviour of light and heat is the same.

The action of lenses on light and heat was then demonstrated, the invisible heat-rays being brought to a focus as readily as the rays of light.

A beam of light was then made to strike a concave mirror, and at the focus, which was strikingly visible in the dust of the room, the thermo-pile was placed, having its face covered. The light being cut off by the dark cell, and the covering screen drawn away, the needle of the galvanometer at once flew to its stops.

Double refraction by Iceland spar was next described and explained. It was illustrated by passing through the spar a circular beam of light, which, on the screen, gave two images. The places on the screen where these two images fell were marked, and the light was cut off by the iodine cell. On introducing the thermo-pile with its face towards the lamp, when it occupied the position of either light-image, a deflection of the needle was obtained. Of the two images, one is the ordinary, the other the extraordinary. Is the same true of the heat? Placing the pile in the place of the ordinary image, cutting off the light, and turning the spar, the deflection of the needle remained unchanged; but when the spar was turned round, while the pile occupied the place of the extraordinary image, the needle instantly fell. Why? Removing the dark cell and rotating the spar, the extraordinary light-image was seen to rotate round the ordinary one, which remained fixed. The heat-beam did the same and thus quitted the pile. Here, then, we prove that the heat-beam also has its ordinary and extraordinary image. This, it was believed, was the first time the effect had been obtained with purely invisible heat. Knoblauch had demonstrated the double refraction of heat, using the total beam, luminous and non-luminous, of the sun.

Some of the phenomena of polarisation were next touched on. Light is propagated by the undulations of an etherial medium, the direction of vibration being perpendicular to the direction of propagation. A crystal of tourmaline has the property of quenching all vibrations except those which are parallel to the axis of the crystal; hence, a plate of tourmaline cut parallel to the axis will allow all vibrations in that direction to pass through it, but will stop all others. A beam of light which has passed through one plate of tourmaline is, therefore, unable to pass through another placed transversely to it, whereas, if the axes are parallel, the light is but little dimned by the second plate. The black space due to the superposition of the crossed plates of tourmaline was shown, as also the abolition of the darkness by a thin film of mica introduced between the plates.

A beam with all its vibrations reduced to the same plane is called a beam of *plane polarised light*.

The two beams emergent from double-refracting spar are thus polarised. Nicol got rid of one. He cut a parallelepiped of spar into two by a very oblique section, polished the two surfaces, and united them by Canada balsam. The ordinary or more powerfully refracted ray, at the surface of the balsam is, in consequence of its obliquity, totally reflected, and the extraordinary ray passes on alone. In this way we obtain an intense beam of polarised light.

A beam of light was sent through two large Nicol prisms, and shown to be entirely extinguished when the principal sections of the prisms crossed each other. The introduction of a plate of mica between them caused, as in the case of the crossed tourmalines, the instant reappearance of the light. The opaque cell was then placed in front of the lamp, all visible rays being thus intercepted. The thermo-pile was next placed so as to receive the beam after leaving the second Nicol prism. Causing one of the crossed prisms to rotate, a path was opened for the heat exactly as for the light, the deflection of the needle speedily bearing witness to the fact. The prisms being again crossed, the heat-beam was again quenched; but as in the case of light, the introduction of a piece of mica restored the heat and caused a large deflection of the galvanometer.

Faraday's great experiment was next performed. A beam of light, polarised by one Nicol's prism, was made to pass through a piece of heavy glass placed between the perforated poles of an electro-magnet, and afterwards through another Nicol, so placed that the beam was extinguished. When the magnet was excited the plane of polarisation was caused to rotate, and a luminous image flashed instantly out upon the scene. The effect of magnetisation is greatly augmented by adopting the device of MM. De la Provostaye and Desains, of causing the principal sections of the Nicol's prism to enclose, not a right angle, but an angle of 45°. This was done, the heat falling on the pile being neutralised by the method of compensation. On sending a current round the magnet a considerable deflection of the needle was obtained, the direction of the deflection depending on that of the magnetising current.

De la Provostaye and Desains thus obtained with luminous solar heat a deflection of 2° or 3°. With the iodine filter and the electric lamp a deflection equivalent to 150 of the lower degrees of the galvanometer was obtained from purely non-luminous heat.

* Iodine in bisulphide of carbon.

THE SUCCESSIVE ACTION OF SODIUM AND IODIDE OF ETHYL ON ACETIC ETHER

CRITICALLY EXAMINED AND INTERPRETED ON THE PRINCIPLES OF THE TYPO-NUCLEUS THEORY.

By OTTO RICHTER, Ph.D.

(Continued from p. 211.)

PART II.

On the Genetic Relations and Chemical Constitution of that Series of Chemical Compounds and Derivatives which emanate from Mr. Wanklyn's Experiments.

IN taking notes of this case, and while Frankland's report was still fresh in my memory, I could not help being struck with Wanklyn's sweeping and emphatic statement, that little or no hydrogen gas was emitted during the reaction. This perplexing but well-authenticated fact appeared to me so full of weight and significance as to rouse in me the suspicion that the two processes differed materially from each other in their *modus operandi*. It was in one of those lucky moments which, like angels' visits, are few and far between, and while I was contemplating my formula for acetic ether that the bright idea flashed across my mind, to which these lines may be said to owe their existence. I conceived that in the conditions prescribed by Wanklyn no hydrogen gas could be evolved, because the action of the sodium on the acetic ether was

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directed entirely and exclusively towards the oxygen of the oxalic acid, which plays here the part of a principal, while in the conditions prescribed by Frankland abundance of hydrogen gas should be evolved, because the action of the sodium on the acetic ether was directed entirely and exclusively towards the hydrogen of the methyl, which plays here the part of an adjunct. By availing myself of this very reasonable hypothesis, and elaborating it in accordance with the principles of the "typo-nucleus" theory, I am now able, I flatter myself, of submitting a perfectly intelligible, consistent, and comprehensive analysis of the various molecular changes which accompany the formation of the substances we are about to consider.

Mr. Wanklyn, under the natural, but erroneous, impression that Professor Frankland had along been experimenting with impure materials, and that his somewhat exaggerated torrents of hydrogen were really due to the action of sodium on certain quantities of water and alcohol, with which the acetic ether was contaminated, or which had been engendered during the reaction, and finding that an elementary analysis of his compounds led to the same empirical formulæ with those of Frankland, committed the very pardonable mistake of insisting on their chemical identity. My present object is to show on theoretical grounds that the two sets of compounds are not identical, but only isomeric, and I shall feel exceedingly obliged to those chemists who have been working on this subject to test on practical grounds the soundness and validity of my mode of reasoning. For this purpose, I shall select the following passage from one of Wanklyn's numerous contributions to this case. I shall quote it verbatim, but take the liberty of doubling his empirical formulæ. He says—

"With reference to Frankland's and Duppa's paper in the London *Philosophical Transactions*, it will be found that the products described by them as obtained from the 'wax-like mass' and iodide of ethyl are the following:—(*a*) $H_{28}C_{32}O_{12}$, a liquid boiling at 195° C.; (*b*) $H_{36}C_{40}O_{12}$, a liquid boiling at 212° C.; butyric ether, caproic ether, some unacted upon acetic ether, and considerable quantities of common ethylic ether. I have already shown that the direct products of the action of sodium on acetic ether are ethylate of sodium and sodium triacetyl. Nothing else seems to be produced directly, but the excess of acetic ether, which is necessarily taken, acts on some of the ethylate of sodium, producing alcohol and acetate of ethylen-sodium in the manner described by me on a former occasion. We have, therefore, in the wax-like mass, got by prolonging the action of sodium on acetic ether—Ethylate of sodium, $H_{10}Na_2C_8O_4$; sodium-triacetyl, $H_{18}Na_2C_{24}O_{12}$; acetate of ethylen-sodium, $H_{14}Na_2C_{16}O_8$; and alcohol, $H_{12}C_8O_4$. On the first three iodide of ethyl acts, giving iodide of sodium and organic liquids. From the ethylate of sodium comes the common ether. From the sodium-triacetyl comes ethyl-triacetyl, which is (*a*), having been got by Geuther from the pure sodium-triacetyl. From isolated acetate of ethylen-sodium and iodide of ethyl I have recently obtained liquid (*b*), thus:

$$2H_{14}Na_2C_{16}O_8 + 2H_{10}C_8I_2 = 2Na_2I_2 + H_{12}C_8O_4 + H_{36}C_{40}O_{12}.$$

The liquid prepared by me boiled at 212° C., and gave carbonate of baryta with baryta-water, and was identical with Frankland's (*b*). By the action of liquid (*a*) upon ethylate of sodium, Geuther has recently shown that butyric ether is produced thus:

$H_{28}C_{32}O_{12} + H_{10}Na_2C_8O_4$ = acetate of ethylen-sodium, $H_{14}Na_2C_{16}O_8$ + butyric ether, $H_{24}C_{24}O_8$.

Finally, I predict that liquid (*b*) will give—

$H_{36}C_{40}O_{12} + H_{10}Na_2C_8O_4 = H_{14}Na_2C_{16}O_8$ + caproic ether, $H_{32}C_{32}O_8$."

It is meet that I should likewise advert to some other experiments, which were devised by Wanklyn, with the view of demonstrating the total absence of hydrogen gas during the action of sodium upon certain species of compound ethers. This was proved in the case of butyric, valeric, and benzoic ether, and it must have given our esteemed colleague no small satisfaction when he was informed by Frankland himself (*Proceedings of the Royal Society*) that sodium dissolves in valeric ether under ordinary atmospheric pressure without evolution of hydrogen gas. "This reaction," adds the learned Professor, "whatever its nature may be, which thus proceeds readily with ethylic valerate, can scarcely be impossible with its homologue, acetic ether, and it is probable that this reaction goes on side by side with those we have described in our memoir; but when the pressure is moderate, those changes chiefly take place which involve the disengagement of hydrogen, whilst under great pressure the reaction observed by Mr. Wanklyn comes into prominence." Thanks to these seasonable, and, to the writer, highly honourable, concessions (honourable, because the hand that committed them to paper was by the same act offering the olive branch of peace—not, indeed, as a token of tame surrender, but as a proud testimony that the love of truth was overruling every other consideration), I was not long in compounding a proper diagnosis of the whole case. This I accomplished by applying my peculiar mode of reasoning to the simple equation which Wanklyn gives in recording the results of the action of sodium on valeric ether. I had thus the satisfaction of discovering what, in musical language, might be called the key-note, in which this chemical tune and all its variations are composed. The only products of this reaction are ethylate of sodium and valerite of soda, according to the equation—

$$\frac{2H_4C_4;H_2O_2.}{2H_9C_8;2C_2O_2} + 2Na_2 = \frac{Na_2O_2.}{2H_4C_4;H_2O_2} + \frac{Na_2O_2.}{2H_9C_8;2C_2O},$$

clearly showing that the $2Na_2$ are first of all oxidised into $2Na_2O_2$ at the expense of the oxalic acid, which is thereby reduced to oxalous acid, and which, together with its butyl-adjunct, constitutes the valerous acid, $2H_9C_8;2C_2O$. In the second stage, the newly-formed soda, $Na_2O_2.Na_2O_2$, acts on the valerous ether, when, by the process of double decomposition, the two basic nuclei, Na_2 and $2H_4C_4;H_2$, interchange places, with formation of ethylate of sodium and valerite of soda. With this valuable key in our possession, let us now analyse the equation which Wanklyn proposes in order to account for the fact that nothing else is obtained in his experiment than sodium-triacetyl and ethylate of sodium. From this equation, of the correctness of which I myself am thoroughly convinced, it would appear that four sodium molecules are matched against three molecules of acetic ether. Accordingly we have—

$$3\left(\frac{2H_4C_4;H_2O_2}{2H_4C_4;2C_2O_2}\right) + 4Na_2 = \text{sodium-triacetyl:}$$

$$\frac{H_2O_2.}{2H_4C_4;H_2O_2:2C_4} \cdot \frac{H_2O_2.}{H_2O_2:2H_4C_2;2C_2O} \cdot \frac{Na_2O_2.}{2H_4C_4;H_2O_2} + 3\left(\frac{Na_2O_2}{2H_4C_4;H_2O}\right),$$

and the two first stages of the process are completely analogous to those which accompany the action of sodium on valeric ether, the resulting products being two molecules of acetite of soda and two molecules of ethylate of sodium. The third stage I hold to be marked by the re-solution of the third co-operating molecule of acetic ether into ethylic alcohol, and the hypothetical deacetylic alcohol (see p. 218), which instantly unites with one of the two newly-formed molecules of acetite of soda, with production of the complex molecule—

$$\frac{H_2O_2.}{2C_4;H_2O_2:2H_4C_2;2C_2O} \quad \frac{Na_2O_2.}{}$$

corresponding to the unknown aceton-carbonite (diacetite) of soda. In the fourth stage, an interchange of basic nuclei takes place between the newly-formed ethylic alcohol and the second molecule of acetite of soda with production of acetite of water, and the third molecule of ethylate of sodium. In the fifth and last stage, this acetite of water, after merging into the isomeric diethylic alcohol, combines under that form with the before-mentioned aceton-carbonite of soda, yielding thereby, as the final product of the reaction, the diethaceton-carbonite of soda, which I hold to be identical with Wanklyn's sodium-

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triacetyl. Wanklyn, on the other hand, who is still reasoning and writing under the spell of his polyatomic sodium theory, imagines that, when his sodium-triacetyl is treated with acetic or hydrochloric acid, it becomes by no means converted into hydrogen-triacetyl, but into an isomeric body which he is pleased to call acetate of acetylinated ethyl. Experiment alone can decide between his and my mode of arguing, and since, according to my formula, this substance ought to possess the well-pronounced chemical properties of a triatomic compound, it would not be difficult for Mr. Wanklyn to determine this point at his leisure. I may here mention that, in consideration of its origin from acetic acid, and to record the alcoholic nature of its two adjuncts, I have registered the corresponding water-salt (Wanklyn's hydrogen-triacetyl) under the term acetalconite of water, and the water-salt which corresponds to the before-mentioned aceton-carbonite of soda, from its being a homologue of the pyruvite of water, under the term acepyruvite of water (*vide* table of genetically-related water-salts).

Having now submitted to the reader what I believe to be a substantially correct analysis of the chemical process of which sodium-triacetyl and ethylate of sodium are proved to be the only products, I shall remark in the next place upon the pretended identity of Wanklyn's derivatives with those of Frankland. "When sodium-triacetyl," says our learned expositor in the above-quoted passage, "is acted upon by iodide of ethyl, there is formed ethyl-triacetyl, which is (*a*), having been got by Geuther from pure sodium-triacetyl." This is an important statement, for it shows that the substance with which Geuther performed his experiments, and to which he applies the name "sodiodiacetic ether," is regarded by Wanklyn as identical with his own sodium-triacetyl. But in what precedes I think I have satisfactorily demonstrated that Geuther's compound, no matter whether it was obtained by Frankland's method or by the action of ethylate of sodium on acetic ether, is identical with Frankland's sodaceton-carbonic ether, and therefore, and notwithstanding the congruence of their empirical formulæ, constitutionally distinct from Wanklyn's sodium-triacetyl. This being understood, a mere glance at their formulæ will convince the reader that the displacement of the sodium by ethyl can, in the corresponding derivatives of ethaceton-carbonic ether and ethyl-triacetyl, give birth to a couple of isomerides only. Wanklyn further alleges that he has obtained the compound (*b*), and he rests his proof of its identity with Frankland's diethaceton-carbonic ether on the fact that the liquid showed the same boiling-point and gave carbonate of baryta with baryta water, while he is ominously silent concerning the other products of the reaction. Without entering into details, I shall simply observe that the circumstance of Frankland's compound being derived from the action of two molecules of iodide of ethyl on one molecule of disodaceton-carbonic ether, whereas Wanklyn's compound is derived from the action of two molecules of iodide of ethyl on two molecules of acetate of ethylen-sodium (sodacetic ether), this circumstance, I say, trivial though it may appear at first sight, does not augur well for the hypothesis of their chemical identity. I am unable to tell whether Wanklyn has succeeded in isolating the caproic ether, which, according to his view, ought to be obtainable from liquid (*b*) by the same method which enabled Geuther to produce butyric ether, viz., by the action of liquid (*a*) on ethylate of sodium. The reader will bear in mind that the liquid under consideration is the ethaceton-carbonic ether of Frankland; consequently the butyric ether here spoken of, and which remains after the removal of the colligated deacetylic alcohol and its conversion into sodacetic ether with the aid of the ethylate of sodium, must be identical with the ethacetic ether of that chemist. Let us now inquire into the molecular structure of the butyric ether, which Wanklyn obtained by applying Geuther's method to his own liquid (*a*), and which he is now pleased to call "butyrate of acetylinated ethyl," in preference to the original and more appropriate term, "ethyl-triacetyl. The *rationale* of the process is precisely as in the former case, but a comparison of the two formulæ—

$$\frac{2H_4C_4 : H_2O_2}{2(H_4C_4 : H\,C_2) ; 2C_2O_2} \text{ and } \frac{H_2O_2 . \quad 2H_4C_4 : H_2O_2 .}{2H_2C_4 : H_2O_2 : 2H_2C_2 ; 2C_2O}$$

plainly shows that Geuther's butyric ether and Wanklyn's butyric ether stand to each other in the relation of isomeric bodies only. And here I cannot help expressing my surprise that Mr. Wanklyn should never have drawn in question the identity of these two species of butyric ether, while he freely admits the non-identity of their corresponding sodium compounds. In proof of this, I take the liberty of quoting a sentence which occurs in his paper "On the Salts of Acetylinated Ethyl." He says—"The third compound (caproate of acetylinated ethyl) is produced by the action of iodide of ethyl on acetate of ethylen-sodium (the *isomer* of butyrate of soda, recently described by me, which yields alcohol and acetate of soda when treated with water)." I must not forget to mention that, by heating a mixture of one molecule of ethdiacetic ether, one molecule of acetic ether, and one molecule of ethylate of sodium in sealed tubes, Geuther actually succeeded in obtaining two molecules of butyric ether for every one of ethdiacetic ether, a molecule of acetate of soda being formed at the same time. It is clear, therefore, that the first stage of the process consists in the production of one molecule of butyric ether and one molecule of sodacetic ether, which in the second stage, by exchanging its sodium for the ethyl of the accessory acetic ether, gives rise to another molecule of butylic ether and acetate of soda. Geuther's experiment is highly interesting in this respect also, that it seems to afford yet another instance of the modifying effects of external pressure upon the results of the reaction, for in the formation of Frankland's sodaceton-carbonic ether, which takes place at the ordinary atmospheric pressure, the two conflicting molecules of acetic ether and sodacetic ether resolve themselves into alcohol and sodaceton-carbonic ether; while in the formation of Geuther's butyric ether, which takes place under high pressure, the two conflicting molecules of acetic ether and sodacetic ether resolve themselves into butyric ether and acetate of soda. Finally, as regards the caproic ether, which Wanklyn expects to obtain from his liquid (*b*) with the aid of ethylate of sodium, I feel convinced that it is Frankland who, in his liquid (*b*), holds the right substance for this experiment, because my formula of the diethaceton-carbonic ether plainly shows that, after the removal of the colligated deacetylic alcohol, and its conversion into sodacetic ether under the influence of the ethylate of sodium, the remaining portion of the molecule must be diethacetic or isocaproic ether, while, under the same treatment, the liquid (*b*) of Wanklyn ought to resolve itself into a molecule of ethacetic ether and a molecule of sodethacetic ether. I shall wait patiently for the experimental answer to these prognostications; but whether my theoretical deductions be confirmed or contradicted, it is certain that our charming science will always be the gainer in the end. With these observations I shall now proceed to the third and last part.

(To be continued).

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, May 2nd, 1872.

DR. FRANKLAND, F.R.S., President, in the Chair.

WHEN the minutes of the previous meeting had been read and confirmed, Messrs. Charles Thomas, E. H. Morton, Thomas Tyrer, Mark Finch, and G. Packer were formally admitted Fellows of the Society.

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The following names were read for the first time:—Messrs. George Elliott Barker, H. Smith, Richard Hayton Davis, Richard Weaver, and Francis Henry de Rheims, jun.

For the third time—Messrs. Richard Anderson, and George Cordwent, M.D., who were then balloted for and duly elected.

The PRESIDENT then called on Mr. E. RILEY to deliver his lecture on "*The Manufacture of Iron and Steel.*"

The author, in his lecture, confined himself chiefly to the influence of the elements associated with iron in the pig, and the part they play in the subsequent conversion of the pig- into wrought-iron and steel; considering the present system of smelting in blast-furnaces to be so simple that it was difficult to see how any process can compete with it except in exceptional cases.

Although in certain districts there is not much variation in the pig made, the same ore and fuel being constantly used, yet in others, as South Wales, and Staffordshire, so many varieties of ore are employed that pig of all descriptions is produced. From the results of analyses of samples of Yorkshire cold-blast pig (No. 1 to 6 iron) from the same works, it would appear that, whilst the phosphorus is almost constant in all the kinds, about 0·64 per cent; the quantity of sulphur decreases, and that of the silicon increases with the number. It is probable that the differences in the amount of sulphur present would explain the differences in the quality of the pig, for it is certain that sulphur makes grey iron into white. At the same time, however, the different numbers in grey iron may be produced by differences in the rate of cooling. The author criticised Mr. Bell's process for determining sulphur in iron, and gave details of the one he had himself employed. On examining the pigs of which the best wrought-iron is made, they will be found to contain silicon and phosphorus, Swedish iron, which contains no phosphorus and but little silicon, when used by itself giving a red-short iron. Hæmatite pig is special in its character on account of its freedom from phosphorus and its adaptability for the Bessemer process, although the amount of silicon present is not unfrequently as high as 4 or 5 per cent.

The chief constituents of pig-iron are carbon, silicon, sulphur, phosphorus, and manganese, traces of copper and titanium (the latter only in grey iron), frequently nickel and cobalt, and occasionally vanadium and arsenic. The percentage of carbon in pig-iron varies from 3 to 4 per cent, but the question as to whether it forms any definite compound with iron is open to great doubt. Mr. Snelus has shown that, by sifting out the finer portions from the borings of Middlesbro' pig, a material could be obtained containing 7·0 per cent carbon, and by elutriation one containing more than 41 per cent. Sulphur seems always to be derived from the sulphide of iron that may be present in the fuel or ore, but from some experiments it would appear that an excess of lime may act on the sulphide of iron in the coke and convert it into sulphide of lime and metallic iron. Silicon is always present to a greater or less extent in iron, and the author has succeded in obtaining an alloy of silicon and iron containing as much as 21·7 per cent of the former. It is quite insoluble in hydrochloric acid, and only slightly acted on by *aqua regia*. With respect to phosphorus, practically speaking, all that is present in the ore and in the fuel used passes into the pig-iron.

After some remarks on the comparatively little value of titanium as an ingredient in pig-iron, the speaker discussed the quality and composition of the fuel employed in smelting, and then passed on to the process of refining. The time required for refining iron seems to depend on the amount of silicon present in the pig, much of it being separated during the operation and also some sulphur and phosphorus and a little carbon. The process of puddling was then described, and the merits of the various machines invented for that purpose discussed, with especial reference to the results obtained with that of Mr. Danks. The great advantage of machine puddling is the uniform quality of the wrought-iron made. In conclusion, the author made some remarks on steel, particularly with regard to the occurrence of silicon in it. This valuable and elaborate memoir was copiously illustrated with analyses.

The PRESIDENT said the Society was much indebted to Mr. Riley for his interesting and exhaustive lecture containing an account of his long and extensive series of researches. There were several points of interest which he hoped would give rise to discussion, amongst which he might mention the very large percentage of carbon, or, rather, material containing carbon, which could be separated mechanically from borings of iron by sifting or washing. He had felt much interested in the action of a large excess of lime in withdrawing a portion of the sulphur from iron, but most certainly should not have anticipated that an ore containing a large percentage of baric sulphate should have reduced this to sulphide without any of the sulphur passing into the iron. The concluding part of the discourse, giving the author's testimony to the success of machine puddling, was very interesting.

Mr. W. MATTIEU WILLIAMS remarked that he was afraid the lecturer could only have seen his paper on burnt iron and steel in abstract. He had found on taking a number of samples of iron borings and treating them with dilute acid in the manner he had described, he could tell those which were burnt from those which were unburnt. In the former case the liquid became of a very dark colour at first—whilst hydrogen was rapidly given off—from the minute dark particles suspended in the liquid, rendering it turbid. Re-heating and re-rolling improves iron only to a certain extent; after that point it becomes burnt, which may readily be detected by black particles making their appearance in the previously bright silky fracture. Although he quite agreed with Mr. Riley as to the small value of an alloy of titanium with iron, he believed titanic acid to be useful during the process of manufacture.

Dr. WRIGHT said, in reference to Mr. Bell's experiments on the Cleveland pig, in which he had assisted, that it was found that some white pigs on solution left behind a larger quantity of carbon than some grey pigs; he believed the carbon existed in pig-iron in a state similar to that of a solidified solution. When the carbon is able to crystallise out readily, it forms grey pig, and when with difficulty white; the quantity of carbon carried off as hydrocarbons on solution depending on the size of the particles of carbon, the smaller ones being taken up more readily by the hydrogen. Mr. Bell had found that pure carbonic oxide passed over iron oxide at a white heat does not completely remove all the oxygen, so that he believed the completion of the reduction in the blast-furnace to be effected by the potassium cyanide in the lower part of the furnace.

Dr. WILLIAMSON remarked that he had gathered from Mr. Riley's interesting communication that he seemed to think that the blast-furnace was likely to remain the basis of our operations: he could not conceive that a means so grossly faulty could continue to be so. The process was so very rough and crude, not only adding carbon to render the iron more fusible, but at the same time introducing injurious ingredients like sulphur and phosphorus.

Mr. RILEY, in reply, said that Mr. Williams had scarcely answered his objections; he had carefully repeated his process, and his assistant had also tried it, but they had both failed to observe the darkening described by him. He quite agreed with Professor Williamson that the blast-furnace was a very rude and unscientific apparatus; but when we consider the enormous amount of material operated on which has to be converted into iron at a labour cost of two or three shillings per ton, it will be evident that all improvements should have the object of saving labour. It was quite possible to produce almost chemically pure iron, but only at considerable cost.

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The PRESIDENT, after calling on the Fellows present to pass a vote of thanks to Mr. Riley by acclamation, adjourned the meeting until Thursday, May 16th, for which eight communications are announced, including a letter from M. Maumené of Paris, a paper on "Chinoline and Leucoline," by C. Greville Williams, and "New Tests for some Organic Fluids," by Dr. Wanklyn.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, April 2nd, 1872.

J. P. JOULE, D.C.L., LL.D., F.R.S., Vice-President, in the Chair.

MR. S. C. TRAPP and Mr. G. C. Lowe were appointed Auditors of the Treasurer's Accounts.

Ordinary Meeting, April 16th, 1872.

E. W. BINNEY, F.R.S., F.G.S., President, in the Chair.

Among the donations announced were a number of MS. Journals and Papers of the late Mr. Thomas Heelis, F.R.A.S., presented by Dr. Crompton and Mr. John Heelis. On the motion of Mr. Baxendell, seconded by Professor Reynolds, it was unanimously resolved that the thanks of the Society be given to Dr. Crompton and Mr. John Heelis for their valuable donations.

The Rev. Joseph Freeston was elected an Ordinary Member of the Society.

The President said that too much attention could not be called to the drains connecting dwelling-houses with main sewers. Of course in all modern houses it is supposed that such communications are effectually trapped, so as to prevent sewage gases gaining access to the houses. However, it is to be feared many of the so-called traps are traps to catch and transmit disease, and not to stop it. He had himself, at his residence in Crumpsall, a drain from a sink-stone communicating with the sewer, and for the last few years it had acted moderately well, except during sudden falls of the barometer, when smells would get into the house in spite of the traps. During the past summer a servant having found some sewage gases escaping into the yard, from the eyes communicating with the sewer, trapped them. When he (the President) returned home last autumn he found the yard quite free from smells, but his house full of them, the traps in the yard having forced them inwards. No time was lost in cutting the pipes communicating with the sewer, so as to allow the refuse water to discharge itself into the open air and fall into a stench trap communicating with the sewer. This has effectually stopped all smells from sewage gases entering his house. The connection of house drains with main sewers is no doubt a fertile source of disease, and in some cases even the means of transmitting it from house to house.

Mr. Richard Weaver, Sanitary Engineer and Chemist, 20, Nile Street, Leicester, had lately informed him that he (Mr. Weaver) had some seven months ago visited Sunderland, then suffering from a smart attack of small-pox. The sanitary officer and chairman of the Health Committee stated that the sewers had excellent ventilation. This excellent ventilation consisted of six openings into chimney stacks, for the most part at the lower extremities of sewers. Now, until the fallacy was pointed out, the responsible authorities considered six openings, promiscuously selected, sufficient for the ventilation of probably fifty miles of sewers and drains, many of them on very steep ground, and the tide flowing up twice in twenty-four hours.

Mr. Weaver found, as he expected, the epidemic most severe on the outskirts and suburbs, in places of fine situation, and open country. Here was street upon street where the sewage had spared scarcely a house, and in almost all was a more or less powerful odour of sewer gas. Now this was remarkable, and the explanation he discovered, after some trouble, although the authorities could tell him nothing of it, that many of these streets had a special sewer laid down in front of the houses, with a branch run under the floors of each building, which were filled up with ashes, and the pipe left open for the purpose of removing sub-soil water! The lower end of each sub-soil sewer joined the mains, contact being supposed to be broken by a syphon, but as these were never looked at from the day of being laid, and as no water flowed from the cellars, in dry weather the syphon speedily became untrapped, and an uninterrupted flow of gas proceeded into the houses.

A very good proof of this being the mode of propagation of the disease was furnished in one-half of a street, that is on one side of it, being without any drainage whatever, and had not a single case of small-pox. Now here the privies and slops overflowed the yard and lane, and the stench was most unbearable, yet this side escaped. Opposite, all was much cleaner to the eye, but the sewage gas was within the houses, and so was the epidemic. So much for our vaunted sanitation!

Now assuming this statement of Mr. Weaver's to be true, it appears that in some cases the germs or particles of disease are communicated by drains and sewers from house to house, and that untrapped or badly trapped ones are far worse than having no drains at all.

"*On a new Theory explanatory of the Phenomena exhibited by Comets.*" By DAVID WINSTANLEY, Esq.

An explanation of the phenomena exhibited by cometary bodies seems to have been generally sought for amongst the most hidden of Nature's operations; indeed inventors of theories would appear to have taken it as an axiom that the extraordinary and imposing aspects which are frequently presented by the heavenly bodies in question can only be explained by the operation of natural laws which here we do not know, by the existence of chemical substances which here we have not got, or by the presence elsewhere of conditions which here we do not find. To me it does not seem that the causes of cometary appearances are of necessity deeply hidden, nor that the invention of new natural laws, new chemical substances, or new conditions of matter, offers us a more philosophical or even a more handy means of accounting for those appearances than without them we already possess.

It is undoubtedly in the presence and the configuration of their tails that we recognise the greatest visible differences from the planets which comets exhibit. But these visible differences, curious and interesting as they are when present, are sometimes wholly wanting, ofttimes merely rudimentary, and when existing are continually altering their dimensions and their forms. There are, however, two points in which comets constantly differ from the other members of our system, and these points are to be found in the smallness of their mass and the eccentricity of their orbital paths. It is in these ever-present points of dissimilarity that I apprehend we shall find the cause of those visible, those varying, and those incidental differences from the planets, with which the term comet has become inseparably associated. It has not been observed that the smallest comets are most remarkable for their phenomena or their aspects. On the contrary, the larger bodies of the class have always presented the most striking appearances, whence I infer that though these appearances are beheld only in connection with bodies of comparatively trivial mass, yet that insignificance of mass is not the primary element in the formation of the phenomena under consideration. The eccentricity of their orbits, however, having been a noticeable feature in connection with all the most remarkable comets, it is in this particular, and the circumstances which accompany it, that I think the clue will be found to

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a solution of the enigma of their aspects. The most obvious difference from the planets which we might expect in the case of a comet on account of the smallness of its mass would be the feeble coercion of the elastic power of its gaseous parts, and the consequent voluminous development of its atmosphere, whilst the eccentricity of its orbit would undoubtedly give rise to enormous changes in temperature of the particles composing it. It is in this extension of atmosphere, and in the suddenness and violence of these thermal changes, that I think it possible to find an explanation of almost every one of those appearances which are peculiar to comets as the ordinary and every day phenomena of their meteorology.

Suppose, for instance, we have a planetary body composed of such materials as the earth is made of, and as the spectroscope indicates as entering into the composition of the sun,—and suppose this planetary body to be in comparison with our globe extremely small in mass, and located at such a distance from the sun as to be sensibly affected by his rays (say, for instance, within Saturn's orbit),—and suppose, further, that it is retained at that distance until such changes as would be produced by the temperature to which it is there subjected are fully realised; we should then have a central mass of more or less solid material, surrounded by an attenuated atmosphere of such substances as are gaseous at the particular temperature there prevailing, and under the particular pressure exercised by the gravitation of the central mass. Now let us suppose our planetary body to be moved to another position considerably nearer to the sun, and so subjected more largely to the influence of his rays; an augmentation of its atmosphere would immediately be commenced; materials non-volatilisable at its previous temperature would be raised into the gaseous form; the volume of its atmosphere would be increased, whilst the planet's coercive power over its elasticity would be diminished. But let us suppose our planetary body to be once more replaced in its former position, and subjected to the lesser of the two temperatures we have been considering; the solar heat will now no longer be able to maintain all that matter in the gaseous form which has been evaporated at the shorter of the two distances from the sun. A condensation will accordingly be commenced through a greater or less extent of the cometary atmosphere, and a more or less dense nebulous mass will surround the central stellar point. This nebulosity will be again evaporated into transparent gas upon the removal of the body it surrounds to its second position nearer to the sun. But the atmospheric condensation into cloud-like mist which follows the removal of our little planet from the influence of the solar rays would also result from the removal of those solar rays from that little planet, such, for instance, as would be caused by the interposition of one of the planets. Under *these* circumstances a precipitation of misty material would take place,—a precipitation which would, as before, be dissipated at the termination of the eclipse.

A comet, however, is not circumstanced as our hypothetical planet has been. It is not placed at some given distance from the sun and allowed to remain there until the maximum thermal effect has been produced, and then removed elsewhere. It is continually altering its distance from the sun, and, apart from any axial rotation it may have, is continually presenting a fresh aspect to the operation of the solar heat. Vapourised materials issue from its heated surface in jets like steam, and rise towards the sun into the cooler atmosphere above, where they lose a portion of their heat, become partially condensed, and form a canopy of cloud, which, when viewed from the side by the inhabitants of another planet, presents the appearance of a crescent with horns turned from the sun of a hemisphere or a sphere of nebulous matter, according to the amount and aggregation of the misty particles. As the comet approaches its perihelion this misty canopy is dissipated, as transparent gas, into the upper and surrounding regions of its atmosphere, by the ever-increasing power of the sun, whilst fresh jets of steam arise from the heated surface of the central mass, and replenish the stratum of clouds. It is not difficult to find an interpretation of the existence of a number of these cloudy strata floating in the comet's atmosphere, in concentric rings around its central mass, in the presence of atmospheric ingredients of different chemical constitution, or in supplies of vapour furnished from the same source, at different intervals of time, as indicated in the alternate violent action and total cessation of the steamy jets which have been observed to take place. But whilst all this is going on upon the anterior or sunward side of the comet, there is quite another state of affairs on the opposite side. There the planetary mass and its cloudy canopies project their shadows and their shades into a vast conoidal space beyond, a space in which total and partial eclipses of the sun prevail, where the influence of the solar rays is felt with mitigated force, and where, consequently, a misty precipitation is formed, which becomes illuminated in the penumbra by the direct rays of the partially eclipsed sun, and throughout its whole extent by the scattered beams which penetrate the bank of filmy clouds floating over the central planetary mass, and stretching away in a direction from the sun, forms that illuminated appendage known as the cometary tail.

It will be perceived, however, that though condensation would be commenced, where the temperature was sufficiently mitigated, throughout the whole of that conoidal space, darkened by the intervention of the planet and its clouds, yet, when once commenced, the inner particles of cloud being largely protected from further radiation by those external to them, the sum total of condensation would be almost confined to an annular space near the circumference of the shadow; in short, the misty cloud would have the form of a hollow cone, which would account for the frequently observed apparent division of the tail into two lateral branches, for this hollow envelope being oblique to the line of sight at its borders, a greater depth of illuminated matter would there be exposed to the eye.

As the comet proceeds along its path it will project a newer shadow at an angle from that which it has already cast, the mist formed in which latter will be dispelled by the unimpeded action of the solar rays, whilst another portion of the comet's atmosphere will suffer partial condensation, thus causing the formation of a new tail and the dissipation of the old one to take place simultaneously, and accounting for the enormous sweep which the tail makes round the sun in perihelio, in the manner of a rigid rod, and in seeming defiance of gravitation and all mechanical law.

The extent to which condensation in the cometary atmosphere will take place will obviously depend, amongst other things, on the difference of temperature within and without the shadow, and on the length of time during which that difference of temperature is allowed to operate. Now the further from the nucleus we go, the fainter and the more diffuse the shadow will become; and apart from this, as well as in consequence thereof, the less the difference of temperature within and without that shade, and the longer the time required to effect a condensation. Accordingly the axis of the conoidal envelope will lag behind the axis of the shadow, the more so as we recede from the nucleus, thus producing the observed convexity on the tail's orbital preceding side.

The further we are from the nucleus, however, and for the same reason, the longer will be the time required to evaporate the mist already precipitated, and the further, therefore, will be the point at which the mist is cleared from that at which it was condensed, thus accounting for the retrograde curvature of the posterior edge of the appendage, and for the excess of this curvature over that of the opposite side.

The angular separation of the front and rear edges of the tail will clearly be regulated, amongst other things, by the angular capacity of the shadow in which that tail

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is formed, which increases with the comet's proximity to the sun.

Accordingly we should expect this angular separation to be at its greatest in perihelio, which, as a matter of fact, has been observed to be the case. Particular attention was called to this phenomenon in the instance of Donati's comet in 1858, and beautiful plates illustrative of it are given in the 30th volume of the Astronomical Society's *Memoirs* by Prof. Challis and Mr. Warren De la Rue.

The fact that the maximum length and splendour of a comet's tail is attained not at, but after, the passage of the perihelion is only what we might reasonably expect, for, as we know, time is required in which to produce any physical change, and, consequently, that augmentation of the cometary atmosphere resulting from the heat received in perihelio must necessarily be produced some time after that heat has been received, and, therefore, after the perihelion passage.

The diminution in size which the nucleus of a comet undergoes as it approaches the sun, and the subsequent expansion which takes place as it recedes from it, a diminution and expansion which are contemporaneous with, but reversed in order to, the dilation and contraction of the tail, follow as a corrollary to the theory I have laid down, and seem to me strongly to indicate that the tail is really a material appendage of the comet, and not an effect produced by it upon any medium through which it may be supposed to move.

It may be said in objection to my theory that comets are not made up of such chemical substances as I have instanced in the case of the hypothetical planet, to which I would reply "Nor need they be." The theory in question only requires that they should be composed, at any rate in part, of materials evaporable by heat and whose vapours are condensable by cold, and this, I think, apart from being an almost self-evident proposition, the spectroscope has shown to be a fact in the instances of the small comets examined by its aid. It indicates, as I understand, the existence of heated gaseous matter about the nucleus, and of liquid or solid material in a state of infinitesimal division in the substance of the tail.

The six-tailed comet of 1744 will, I have no doubt, be pointed to as one whose phenommena it is difficult to explain in accordance with the theory I have advanced. I would ask those who feel disposed to raise this objection to examine the evidence upon which it is affirmed that the comet in question was really possessed of a multiple tail. To my own thinking, that evidence is so far from being conclusive that it would be premature to offer an explanation of the phenomenon before the appearance of another comet, unmistakably presenting the peculiarities attributed to that of 1744.

There are instances on reliable record in which comets have been known to present two tails curved in opposite directions, others in which the solitary appendage has shown no sign of curvature, and some in which two appendages have existed at the same time, but separated by a larger angle than seems consistent with the meteorological theory. These instances, however, form the small exception and not the rule, and may, moreover, be explained as merely the results of perspective.

I think I have now said sufficient to enable those who hear me to form an opinion as to whether the theory I have propounded is or not likely to prove a satisfactory explanation of some of the more striking of cometary phenomena. The theory is one which, as I take it, explains more and assumes less than is common with such theories. Besides those I have already named, there are other points which I conceive it fully to account for, but upon which it is quite impossible for me to touch in the brief space to which I feel I ought to confine my present remarks. There are points upon which I am of opinion that the application of quantities is practicable, and the theory itself I not only believe to be true, but the truth of it I conceive to be capable of numerical verification. To these and many other matters I hope to invite your attention on some other occasion, if you consider my present treatment of the subject as justifying any further expenditure of your time.

GLASGOW PHILOSOPHICAL SOCIETY.

(Chemical Section).

Monday, April 29th, 1872.

Alexander Whitelaw, Esq., in the Chair.

Dr. T. E. Thorpe made several short verbal communications, two of which were on subjects brought under the notice of the Chemical Society on the 18th of April, and duly noticed in the report in the Chemical News. The first of the others was on "*A Trisodium Phosphate obtained in the Manufacture of Soda.*" The substance spoken of was peculiar in the fact that it contained vanadate and fluoride of sodium. Rammelsberg had analysed a similar substance, and had assigned to it the formula $NaPO_4+10H_2O$, but he (Dr. Thorpe) had arrived at the following formula:—$2NO_3PO_4+NaF+19H_2O$. The vanadium was very small in amount. Dr. Thorpe also briefly referred to a mineral from Sicily, the composition of which was—

Silica	52·71
Triferric tetroxide ..	19·44
Lime	6·61
Magnesia	1·85
Alumina	19·09
	99·70

Papers were afterwards read on "*The Action of Dilute Saline Solutions on Lead*," and on "*A Double Sulphide of Gold and Silver*, by Mr. M. M. Pattison Muir, F.C.S.; on "*The Zircons of Ceylon*," by Mr. M. H. Cochran, F.C.S.; on "*Iona Pebbles*," and on "*The Action of Various Charcoals on Nitrogenous Organic Matter*," by Mr. E. C. C. Stanford; on "*The Part which Iron and Alumina Oxides play in the Manufacture of Super-Phosphate*," and on "*The Comparative Value of Mineral Phosphates*," by Mr. T. L. Patterson, F.C.S.; and on "*The Separation of Phosphoric Acid, Oxide of Iron, Alumina, Lime, and Magnesia*," by Mr. Thomas R. Ogilvie. Most of these papers will appear in our pages.

Owing to the great plethora of papers at this, the closing meeting of the session, there was no time left for discussion; and great regret was expressed that such valuable and suggestive communications should be passed in silence.

CORRESPONDENCE.

SODIUM AND ACETIC ETHER.

To the Editor of the Chemical News.

Mr. Otto Richter's paper, which is being published in the Chemical News, seems to call for a few remarks. He appears to consider that his "Typo-nucleus Theory" derives support from the fact of its accounting for the modifications which pressure occasions in the products of the action of sodium on acetic ether. He appears to imagine that when sodium and acetic ether are brought together at ordinary atmospheric pressure, they yield hydrogen, and when they are brought together at high pressures, they yield little or no hydrogen.

Unfortunately, however, for the "typo-nucleus theory," there is no experimental ground for maintaining "that there exists an intimate relation between the degree of gaseous pressure which is brought to bear upon the mix-

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ture of sodium and acetic ether, and the quantity of hydrogen which is evolved during the reaction."

The origin of this erroneous statement is, I believe, to be traced to a hasty suggestion to be met with in Dr. Frankland's paper in the *Proceedings of the Royal Society*. Dr. Frankland was betrayed into the assertion that the experiments in which hydrogen had been obtained differed from the experiments in which hydrogen had not been obtained by being performed under considerable pressure. Dr. Frankland had, by an oversight, confounded working in a sealed tube with working under pressure. It is hardly necessary for me to point out that working in a sealed tube does not necessarily imply working at higher than atmospheric pressures; indeed, if the tube be boiled out or otherwise exhausted before being hermetically sealed, the working may even be at reduced pressures. In some of the experiments sodium dissolved in acetic ether without sensible evolution of hydrogen at pressures hardly if at all exceeding that of the atmosphere. The physical difference between the experiments was merely a difference in the shape of the vessel employed to contain the materials. Apparently Dr. Frankland employed a vessel somewhat globular in shape, and I employed a vessel of a cylindrical shape.—I am, &c.,

J. ALFRED WANKLYN.

London, May 6, 1872.

ORIGINAL RESEARCH.

To the Editor of the Chemical News.

SIR,—May I be permitted to make a few remarks on the subject which has been handled by "A. T." and "Graduate." I may say that I quite agree with "A. T." when he asks for "recognition," and I agree further with him in thinking that the recognition should be accorded by an existing power, such, for instance, as the Chemical Society. Such a course might be the means of encouraging much good work. Before giving my own views, I would point out what I consider to be a fatal mistake in the suggestions of "Graduate." He asks for more than "recognition" in suggesting that "a system of national, or even international, prizes and rewards for scientific research be instituted." I am sure "Graduate" will forgive my fervour when I say that it appears to me marvellously like making paupers of scientific men to ask that they should receive a bit of sugar-stick for each of their efforts; and to descend to the practicability of the proposed scheme, may I ask "Graduate" who would be entrusted with the distribution of the "prizes and rewards."

The incentive which could be legitimately offered to a scientific man should, I think, be nothing more than the *recognition* of his efforts, and such recognition could be accorded by a society, such as the Chemical Society, in the shape of an honorary title. Such an incentive would reach all classes of science-workers, from the humblest assistant in the laboratory of a chemical works even up to our Metropolitan Professors.—I am, &c.,

SIDNEY W. RICH.

MISCELLANEOUS.

The Royal Society.—The following gentlemen are recommended by the Council for election into the Royal Society on June 6th:—Professor William Grylls Adams, M.A.; Andrew Leith Adams, M.B.; Frederick Le Gros Clark, F.R.C.S.; Professor John Cleland, M.D.; Prof. Michael Foster, M.D.; Prof. Wilson Fox, M.D.; Arthur Gamgee, M.D.; Rev. Thomas Hincks, B.A.; Prof. William Stanley Jevons, M.A.; Prof. George Johnson, M.D.; Prof. Thomas Rupert Jones; Major Thomas George Montgomerie, R.E.; Edward Latham Ormerod, M.D.; Edward John Routh, M.A.; William James Russell, Ph.D.

Broderip Scholarships.—Two Scholarships of the annual value of £30 and £20 respectively, tenable for two years, have been founded by the Governors of the Middlesex Hospital, for the encouragement of the study of Medicine and Surgery, in memory of the late Francis Broderip, Esq., a munificent benefactor to the Hospital. These scholarships will be open to competition, at the end of each winter session, amongst the general students of the Hospital who shall have completed their third year of study at the Medical College. The successful candidates will be required to attend and work at the Hospital for a fourth year, during which period they will be eligible for the various resident appointments.

Highton's Galvanoscope.—The galvanoscope which Mr. Highton exhibited at the Society of Arts, and by which he showed that simply looking at a thermopile was sufficient to signal across the Atlantic, was constructed in the following manner:—A strip of gold leaf, the thinnest which could be procured, was hung vertically between two wires, one at the top and the other at the bottom, and metallically connected with both. There were means by a telescopic movement of adjusting the tension of the gold leaf. The whole was inserted in a small glass chamber with flat walls and placed in a powerful magnetic field. The slightest current sent through the gold-leaf deflects it in a direction regulated by its position with regard to the poles of the magnet. A strong beam of light was then sent across the gold leaf in a direction at right angles to its plane of motion, and by a condensing lens a magnified image of the leaf was thrown upon a screen. The motions of a gold leaf fixed in this manner reveal in a most wonderful manner the slightest variation of an almost infinitesimal current. We hear arrangements are being made for coupling up all the lines to Bombay, and working through in one unbroken circuit by means of one of these galvanoscopes.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, April 15, 1872.

In addition to a large number of papers and memoirs relating to mathematical, astronomical, meteorological, and natural history subjects, this number contains the following papers more particularly bearing upon chemistry:—

Researches on Crystalline Dissociation.—P. A. Favre and C. A. Valson.—The first portion of a monograph treating on the thermical relation of the phenomena of crystallisation and solution. Notwithstanding the very high scientific value of this memoir, elucidated by several tabulated forms exhibiting results of experiments, the contents are not well suited for any useful abstraction.

Industrial Cultivation of Hops.—A. Muntz.—The author has instituted, with great care and on a practically large scale, a series of experiments, with the view of ascertaining the quantity of materials consumed by the hop-plant during its growth and development from spring to autumn (hop-picking time), for a number of 6516 plants placed on a hectare (=2·47 acres). The quantities alluded to, expressed in kilos., are—Water, 11270·270 kilos.; carbon, 2624·361; hydrogen, 315·547; oxygen, 2011·393; nitrogen, 91·141; phosphoric acid, 21·693; magnesia, 24·352; potassa, 41·812; soda, 0·455; non-specifically determined mineral matters, 133·278.

Heat of Formation of the Oxygen Combinations of Nitrogen.—Dr. Berthelot.—A thermo-chemical essay of considerable value, but not suited for abstraction.

Reclamation of Priority on the Subject-matter of a Memoir of M. Grüner relating to the Action of Oxide of Carbon upon Iron and its Oxides.—A. Gillot.—The author states that more than

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four years ago he presented to the Académie a memoir which has never been reported upon, and in which, as proved by a long quotation here reproduced, he made, earlier than M. Grüner, discoveries which the last-named author claims as his own.

Spectrum of Aqueous Vapour.—Lecoq de Boisbaudran.—Illustrated by an engraving.

New Facts relating to the History of Phenols.—L. Dusart and Ch. Bardy.—The authors relate, in the first part of this memoir, the results of a series of investigations made with the view to ascertain whether, by the etherification of phenol, it is possible to reproduce the original body by an inverted reaction. This is found to be the case, so that chloride of phenyl is again converted into phenol; chlorated toluen yields hydrate of cresyl; bromide of naphthyl yields naphthol. In the second portion of this paper the authors state that they have repeated their former experiments, whereby a mixture of chlorhydrate of ammonia, hydrochloric acid, and phenol, heated to 250°, yields diphenylamine, a fact which Girard and De Laire contradicted after having made the same experiment. The result obtained by the first experimenters is the same.

Discovery of a Prehistoric Human Skeleton of the Reindeer Age, at Langerie-Basse (Dordogne, France).—E. Massenat, P. Lalande, and Cartailhac.

La Revue Scientifique de la France et de l'Etranger, April 20, 1872.

This number does not contain any original papers on chemistry, but we call attention to a memoir:—

Transit of Venus over the Sun in 1874.—C. Wolf.—Illustrated with woodcuts.

Bibliography.—Under this heading we call attention to the following recently-published works:—"Le Lendemain de la Mort, ou la Vie future Selon la Science," par Louis Figuier; Paris, Hachette. "Leçons de Chimie Agricole, études sur l'Atmosphere, le Sol, et les Engrais," par A. Bobierre, Directeur et Professeur de Chimie de l'Ecole Supérieure des Sciences et des Lettres de Nantes; 1 vol. in 8vo, with geological map of France and numerous woodcuts; Paris, G. Masson. Both these works are here highly eulogised; the first-named is the fourth and improved edition.

Annalen der Chemie und Pharmacie, April, 1872.

This number contains the following original essays and papers:—

Conversion of the Normal Butyl-Alcohol into Butylen-Hydrate or Ethyl-Methyl-Carbinol.—E. Linnemann.—This is the 15th portion of a monograph treating on the preparation of the fatty alcohols from their initial constituents; the 16th portion of this work treats on the conversion of normal butyl-alcohol into isobutyl-alcohol or fermentation butyl-alcohol; the 17th part treats on the reduction of isobutyric acid into isobutyl-alcohol; part 18 treats on the conversion of isobutyl-alcohol into trimethyl-carbinol; part 19 treats on reversion formations (*Rückbildungen*) in the tetryl series; part 20 (the last) treats on the reversion formation of isobutyl-alcohol from trimethyl-carbinol.

Boiling-point Differences.—E. Linnemann.—This excellent memoir is elucidated by a series of tabulated forms exhibiting the boiling-points of a series of organic substances. The following conclusions can be drawn from the author's researches:—(1.) For an equal difference of composition there is *not* an equal difference of boiling-point. (2). The difference of boiling-point decreases, in the greater number of the hitherto-investigated series, with increase of quantity of carbon—at least this holds good for the initial member (*Anfangsgliedern*). (3.) In many of the series the difference of boiling-point is almost the same, but in others it increases with increase of quantity of carbon. (4.) The isomeric intermediate (*intermediären*) ethers of the fatty alcohols and fatty acids have *no* equal boiling-point.

Action of Chromic Acid upon Oxide of Carbon, Hydrogen, Marsh Gas, and Ethylen..—E. Ludwig.—The author describes at length, and illustrates with a woodcut, his method of manipulating with the gases just named, for the purpose of testing the action of saturated solutions of chromic acid upon them. It appears that carbonic oxide is rather readily oxidised by chromic acid forming carbonic acid; hydrogen, although far more slowly, is also oxidised, water being the result; marsh gas is not at all acted upon, even when left in contact with chromic acid for a week; ethylen is not—at the ordinary temperature at least—very readily acted upon, and, in addition to water and carbonic acid, there is also formed formic acid, and probably acetic acid.

Gas Analysis.—E. Ludwig.—This essay, elucidated by a series of tabulated forms exhibiting results of experiments, treats at length on improved methods for absorbing from gaseous mixtures the following gases:—Sulphuretted hydrogen, sulphurous acid, and carbonic oxide.

Influence of a Change of the Specific Gravity on the Melting-point.—F. Mohr.—The contents of this memoir, notwithstanding its high scientific value, are not well suited for useful abstraction.

How does Salicylic Acid become formed from Brombenzoic Acid fusing at 155°?—H. Hübner.—After first referring to the researches published on this subject by Barth, Remsen, Friedburg, and others, and pointing out the discrepant results of experiments, the author records the results of a series of experiments made with perfectly pure materials, whereby it is proved that perfectly pure brombenzoic acid (fusion-point 155°) does not yield, when fused with caustic potassa, any salicylic acid at all; but the author admits that, as in many other instances, salicylic acid may be formed, as, for instance, when pure phenol is heated to from 193° to 280° for several hours with caustic potassa; so that salicylic acid occurs as a collateral product of reaction.

On some of the Condensation Products of Aldehyde.—Dr. A. Kekulé.—The first instalment of a very exhaustive and lengthy monograph on this subject. Notwithstanding the high scientific value of this paper, it does not admit of useful abstraction,—an observation equally applying to the two following memoirs.

So-called Chloraceten and Polymeric Modifications of Aldehyde.—A. Kekulé and Th. Zincke.

Oxidation of Ketones a means of Determination of the Constitution of the Fatty Acids and Alcohols.—A. Popoff.

Contribution to the History of the Discovery of Chloroform.—Dr. J. Von Liebig.—The eminent *savant* calls attention in this paper to the facts elucidated by several instances, that, owing to political causes, the publishing of French scientific periodicals has been often very much retarded,—so much so that, for instance, the *Annales de Chimie et de Physique* for September and October (double number), 1871, were not published until the middle of February last. Something similar happening in 1831 occasioned Soubeiran's memoir on chloroform (then termed *éther bichlorique*) to appear (1831) after the author's researches on the action of chlorine upon alcohol (a preliminary notice of which was published in Poggendorff's *Annalen* for November, 1831) had been published, and chloroform had been discovered by him. This is also verified by Dumas, who was informed of this discovery six weeks before Soubeiran's memoir was published.

Amides and Anilides of Succinic Acid, their Properties, and Relation to each other.—M. Menschutkin.—This very lengthy memoir is divided into the following sections:—Introduction; metallic derivatives of succinimide into succinamide; transition (*Uebergang*) of imides and amides into amin-acids; transition of succinamide into succinaminic acid; transition of imides into amides; formation of succinimide into succinanil.

Note on Succinalide.—M. Menschutkin.—Pure succinalide, $C_{16}H_{16}N_2O_8$, is insoluble in water, soluble in boiling alcohol and crystallising from this fluid; fusion-point 226·5° to 227°. This body is a very stable compound, completely resisting the action of many strong reagents.

American Journal of Pharmacy, April, 1872.

In addition to several original papers more strictly relating to pharmacy, pharmacognosy, and pharmaceutical technology, this number contains the following original papers and memoirs relating to chemistry:—

Fruit of Magnolia Tripetala.—W. Procter.—The author records at great length the results of his valuable researches on the chemical constituents of the fruit of the tree popularly known in the United States as umbrella-tree, owing to the size of its leaves and flowers. The *Magnolia* tribe is very numerously represented by various species in the States, and among it some most beautiful trees are extant. The main results of the author's investigation show that the fruit of the *Magnolia tripetala* contains a crystalline (resinoid) principle analagous to liriodendrine [the bitter principle of the bark of the tulip poplar, *Liriodendron tulipifera*, also a native of the United States, but introduced into Europe, where it is met with chiefly as ornamental in plantations and parks]; further, a solid resin precipitable by subacetate of lead, a soft pungent resin, fixed oil, volatile oil, gum, glucose; but no investigation was made for acid or colouring matter.

A New Source of Potash Supply.—H. Hazard.—In this memoir the author sets forth the results of his researches of the cobs of Indian corn (*Zea mais*), very largely grown in the United States, and by a series of analyses the fact is brought out that the cobs contain on an average, in 1000 parts, 7·62 parts of carbonate of potassa, or nearly twice as much as the best specimens of wood. The author further exhibits statistical data which prove that, taking the average production of corn in the States alone, there might be extracted from the ash of the cobs (a great portion of which are used as fuel for steam-boilers) a quantity of no less than 51,612 tons of pure carbonate of potassa, while, moreover, a larger quantity of chloride of potassium may be simultaneously obtained: 100 parts of the cobs, dried at 100°, contain on an average 1·171 ash, consisting of 0·899 KCl, 0·836 K_2CO_3, 0·230 silica, lime, iron, and charcoal, and 0·105 loss.

To Detect Sulphuric Acid in Vinegar.—J. T. King.—The following process will detect the 500th part of free sulphuric acid, and is accurate for all practical purposes. An ounce of the vinegar to be examined is, by evaporation upon a water-bath, reduced to about half a drachm, or the consistency of a thin extract; when quite cold, half a fluid ounce of strong alcohol (not methylated spirit) is added, and thoroughly incorporated; the free sulphuric acid will be taken up by the alcohol, to the exclusion of any sulphates; the alcoholic liquid solution should stand for several hours, and then be filtered; add to the filtrate 1 fluid ounce of pure distilled water, and evaporate the alcohol off next by the application of a gentle heat; the remaining liquid is again left standing for several hours, and again filtered; to the filtrate, previously acidulated with a few drops of pure hydrochloric acid, a solution of chloride of barium is added, which, if sulphuric acid be present, will yield a white precipitate.

On Precautions in Dispensing Poisons.—W. C. Bakes.—The contents deserve the serious notice of pharmacists, who may also learn, perhaps with surprise, that oil of peppermint is occasionally adulterated (at least in the United States and Canada) with castor oil and alcohol, the two latter ingredients having been found present, in a sample tested by E. B. Shuttleworth, to the extent of 38·18 and 29·10 per cent respectively.

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Les Mondes, April 18, 1872.

Medical Faculty at Bordeaux.—The Municipal Council of the city alluded to, having requested that there might be established a medical faculty there, have offered—(1) to grant, for at least 12 consecutive years, the necessary buildings, and the keeping of the same in good repair; (2) to furnish the buildings and library with all requisites; (3) to pay yearly all the expenses which may be incurred in excess of those which the State usually pays, and this in addition to an annual grant of £6000, and also in addition to a grant of £132,000 towards the expenses of first establishment. There are now in France only two medical faculties, viz., at Paris and Montpellier; the third was formerly at Strasburg.

Ingeniously-contrived Method for Working under Ground as well as under Water.—F. Durand.—Although strictly an engineering subject, we call attention to this paper, illustrated by engravings and a full text description.

Action of Light upon the Solution of Iodine in Bisulphide of Carbon, and Description of a Newly-contrived Photometer giving Continuous Indications.—Rev. Father F. S. Provenzali, S.J.—The author states that he uses, in his lectures on experimental physics, thermometers filled with a concentrated solution of iodine in sulphide of carbon, because, in consequence of the great coefficient of dilatation, that liquid is very useful to exhibit to students even small variations of temperature. By accident it was found that when such a thermometer is brought from a dark place into the sunshine—even when a very sensitive mercurial thermometer, removed under the same conditions, does not indicate any change of temperature—the thermometer, filled with a concentrated solution of iodine in sulphide of carbon, exhibits a rise. The author, having further investigated this phenomenon, has constructed a photometrical apparatus consisting of two thermometers,—one a mercurial, the other filled with the solution alluded to: these two thermometers exhibit the same indications when placed in darkness, but when placed in daylight the indications of the sulphide of carbon and iodine thermometer exceeds the indications of the mercurial one, the more so as the light is more intense.

Intensity of the Solar Light and that Emanating from other Sources.—Rev. Father F. S. Provenzali, S.J.

MEETINGS FOR THE WEEK.

MONDAY, May 13th.—Royal Geographical, 8.30.
—— London Institution, 4. Prof. Bentley, F.L.S., "On Elementary Botany."
TUESDAY, 14th.—Civil Engineers, 8.
—— Royal Institution, 3. E. B. Tylor, F.R.S., "On the Development of Belief and Custom amongst the Lower Races of Mankind."
—— Photographic, 8.
WEDNESDAY, 15th.—Society of Arts, 8.
—— Pharmaceutical, 11 (Annual Meeting).
—— London Institution, 7 (Conversazione).
THURSDAY, 16th.—Zoological, 4.
Royal Institution, 3. Dr. Tyndall, LL.D., F.R.S., "On Heat and Light."
—— Royal, 8.30.
—— Royal Society Club, 6.
—— Chemical, 8. "Notes from the Andersonian University." David Page and A. D. Keightley, "On the Determination of the Solubilities and Specific Gravities of certain Salts of Sodium and Potassium." Mr. Brown, "On the Influence of Pressure on Fermentation," Part I. C. Greville Williams, "On Chinoline and Leucoline." J. Alfred Wanklyn, "New Tests for some Organic Fluids." C. O. Sullivan, "On the Products of the Transformation of Starch." R. W. Atkinson, "An Examination of the Recent Attack upon the Atomic Theory."
FRIDAY, 17th.—Royal Institution, 9. Prof. Abel, F.R.S., "On the More Important Substitutes for Gunpowder."
SATURDAY, 18th.—Royal Institution, 3. Prof. Roscoe, F.R.S., "On the Chemical Action of Light."

NOTES AND QUERIES.

Extracting Copper Ores.—Can any of your readers inform me whose process is considered the best (practically) for extracting copper ores by the wet process,—that is to say, by precipitation,—and how I can obtain a copy of the same?—F. CANT.

Poisoning by Strychnia.—In the stomach of a dog poisoned by strychnia, it can be detected; but if death has been caused by powdered nux vomica, how can that be proved? as by the methods used for the detection of the alkaloid the powder would still retain its active principle.—G. C.

University of Freiberg.—Can your readers give me information about the University of Freiberg, in Saxony, as a place of instruction in geology, mineralogy, and chemistry? I should also be glad to know which of the German Universities are held to be the best for learning these three subjects, and when their terms end. Any information on these points will oblige.—UNDERGRADUATE.

Arresting Fermentation.—In a letter from Dr. Baker to Surgeon Wells, of the U. S. Navy, published in the *Journal of Materia Medica*, he says, "Catalysis may be illustrated, in a comprehensive manner, by what occurs in distilleries, where it is desirable to arrest fermentation in the 'fermenting tuns' before it reaches the lactic and acetic stages. If a few drops of tallow, from a candle in a melted state, be dropped into fermenting 'wort,' the fermentation immediately ceases, notwithstanding many thousand gallons are acted upon." I should be glad if any of your correspondents will tell me if this is generally known, and if so, what is the explanation.—CARBOLIC.

Grey and Brown Acetate of Lime.—(Reply to S. S.)—The value of the commercial acetates always depends upon the acetic acid therein contained, and the quantity thereof can be ascertained by the following methods:—From a weighed quantity of the acetate to be tested the acetic acid is driven off, by acting upon it with sulphuric acid, in a deep-bellied retort, to which heat is applied; the acetic acid distilled over being condensed in a well-cooled receiver; about the end of the operation a current of steam is passed through the retort, to drive off the last traces of the acetic acid, the quantity of which is ascertained by means of a standard solution of caustic soda. The other method consists in converting the acetate under examination into acetate of soda, and next converting that salt, by ignition, into carbonate of soda, the quantity of which can be ascertained alkalimetrically. As regards acetate of lime, there are three solid varieties of it met with in commerce, viz., the white, grey, and black (or brown) acetate: these contain, of course, variable quantities of pure acetate of lime, which may be present in quantity from 69 to 83 or 85 per cent.

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THE CHEMICAL NEWS.

VOL. XXV. No. 651.

THE MOLYBDATE PROCESS: ESTIMATION OF PHOSPHORIC ACID.

By JOHN PARRY.

I TRUST the following observations, the result of two years' constant practice in the determination of Ph contained in ores, steel, and pig-iron, may be found useful to some of your readers; and if, in giving the method as practised in the laboratory I may be accused of entering into unnecessary details, I must plead in excuse that only by *exactly* working as herein described have I been able to attain both speedy and trustworthy results. I have ceased to use the ordinary nitric acid solution of molybdenum, and in lieu thereof use an aqueous solution of molybdate ammonia, 50 grms. in 1 litre of H_2O.

I had at first great difficulty in getting the whole of the Ph, and in some instances failed to get a precipitate from iron solution known to contain Ph. It was, however, soon observed that precipitation was retarded in a strongly acid solution, and that Ph could not be thrown down from neutral solutions.

It now occurred to me that it would be well to first add a slight excess of NH_3, and carefully acidify with HCl or N_2O_5 indifferently (the latter, however, proved to be the best); and ultimately the HCl solution of ore or iron containing Ph, and about ½ litre bulk, was treated as follows:—

(1). NH_3 added until complete precipitation of Fe_2O_3.

(2). N_2O_5 carefully added in sufficient quantity only to just re-dissolve the precipitated Fe_2O_3.

(3). Heated to boiling; 30 c.c. of molybdate solution added; solution well agitated (glass flasks are most convenient for this); if the usual yellow crystalline precipitate does not appear, solution is again boiled, four or five drops of N_2O_5 added, the flask well shaken from time to time, and more acid added drop by drop until a distinct precipitate appears. The boiling must now be discontinued, or a bulky light yellow precipitate falls down, but the solution must be kept as hot as possible and well agitated from time to time.

Provided the above details are strictly observed, the greater part of the Ph is precipitated almost instantaneously. I have often had the whole down in two hours, failing, on further trial, to get even traces from the filtered solution. Too much care cannot be taken in acidifying with N_2O_5, and some practice is required ere the exact point can be judged.

Chemical Laboratory,
Ebbw Vale Iron Works.

PRELIMINARY NOTICE OF SOME PRODUCTS FROM NATAL ALOES.

By WILLIAM A. TILDEN, D.Sc. Lond.

Nataloïn.

THE aloïn of Socotrine aloes appears to be identical with that obtained from Barbadoes aloes, as they crystallise in the same manner, give the same colour reactions with oxidising agents, and both furnish chrysammic acid by treatment with nitric acid. Natal aloes is a variety which contains a crystalline body of entirely different properties. This was examined for the first time by Flückiger,* and called by him nataloïn. It is readily distinguished from barbaloïn by its comparatively slight solubility either in water or in alcohol, by its crystalline form, and by furnishing, when acted upon by nitric acid, no chrysammic acid, but, as I have found,* picric in addition to oxalic acid. It contains no water of crystallisation. Crystallised from spirit, and dried at 100° C., it gave me the following results:—

1.—0·5066 grm. burnt with a mixture of lead chromate and potassic dichromate gave 1·1070 CO_2 and 0·2775 H_2O.

2.—0·3715 grm. gave 0·8110 CO_2 and 0·1965 H_2O.

The percentages of carbon and hydrogen calculated from these data agree very nearly with the formula $C_{25}H_{28}O_{11}$.

		Theory.	I.	II.
C_{25}	300	59·52	59·59	59·53
H_{28}	28	5·55	6·07	5·86
O_{11}	176	34·92	—	—

They also approximate very closely to the average of the determinations made by Professor Flückiger, though the individual numbers quoted by him diverge very considerably from the mean.

Flückiger's Analyses of Nataloïn.

						Mean.
C	58·99	59·14	61·18	58·38	60·15	59·56
H	6·17	6·24	5·92	5·95	6·24	6·10

Acetyl-nataloïn.

Hitherto, although numerous experiments have been tried, I have found it impossible to obtain a chloro-, bromo-, or nitro-derivative of nataloïn.

When placed in contact with acetyl-chloride, a reaction commences almost immediately, and is complete after warming for a short time. The varnish-like residue left after chasing off the excess of the chloride and hydrochloric acid, was dissolved in a mixture of alcohol and ether. In a short time, well-defined but microscopic crystals consisting of rhombic plates and octahedra were deposited. 0·143 grm. gave 0·307 CO_2 and 0·070 H_2O.

The percentages of carbon and hydrogen agree with the formula $C_{37}H_{40}O_{17}$.

		Theory.	Experiment.
C_{37}	444	58·73	58·54
H_{40}	40	5·29	5·38
O_{17}	272		

This formula is that of nataloïn in which 6H have been replaced by $6C_2H_3O$—

$$C_{25}H_{22}(C_2H_3O)_6O_{11}.$$

Action of Caustic Potash.

The products of the oxidation of socotrine aloes by means of caustic potash were studied some years ago by Hlasiwetz.† By melting this variety of aloes with caustic potash and a small quantity of water, dissolving the mass in water, acidifying with sulphuric acid, and agitating the whole with ether, an ethereal solution was obtained, in which two crystalline bodies were discovered. These were the para-oxybenzoic acid, $C_7H_6O_3$, of Fischer and Saytzeff, and α orcin, $C_7H_8O_2$.

Some Natal aloes was fused with potassic hydrate according to this method; the ethereal solution obtained left an aqueous liquid, and by continuing the distillation a small quantity of acetic acid passed over. On allowing the liquid to cool, a crop of well-formed colourless crystals was deposited; these, separated from the mother-liquor, were re-crystallised. They are only slightly soluble in cold water, and the solution possesses a strongly acid reaction. They melt at about 205° (the point was not accurately determined), crystallising on cooling, and, when more strongly heated, volatilise with partial decomposition. Placed over oil of vitriol, they effloresced.

0·151 grm., dried at 100°, gave 0·3365 CO_2 and 0·065 H_2O. These data give percentages which agree with those required by the formula of para-oxybenzoic acid.

* *Proc. Brit. Pharm. Conf.*, 1871.

* *Pharm. Journ.*, New Series, vol. ii., p. 441.

† *Ann. d. Chem. u. Pharm.*, cxxxiv., 287.

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		Theory.	Experiment.
C_7	84	60·86	60·77
H_6	6	4·34	4·63
O_3	48	34·78	—

The mother-liquor from which these crystals were obtained was brown and syrupy; it was diluted, precipitated by acetate of lead, the excess of lead removed by exact precipitation by sulphuric acid, and the filtered liquid evaporated, first by the aid of heat, then *in vacuo*. A coloured syrupy residue was thus obtained, which gradually set into a crystalline mass. It was too small in quantity to attempt to purify further, but its reactions were carefully compared with those of the three known orcins.

For small quantities of β orcin and resorcin with which these experiments were made I am indebted to the kindness of Dr. Stenhouse.

A weak aqueous solution of each was employed.

(1). Orcin and resorcin with ammonia redden very slowly. β orcin and the new compound turn purplish red in a few minutes.

(2). With potash resorcin gives a green colouration; orcin becomes slowly reddish brown; β orcin and the new compound become rapidly purple, afterwards brown.

(3). A slip of deal, wetted with the solution, and then with hydrochloric acid, and dried, becomes, in the case of resorcin, blue; with the others a rich purple colour is produced.

(4). Aqueous chlorinated soda gives, with resorcin and orcin, a violet colouration which almost immediately changes to a dull green. With β orcin and the compound from Natal aloes an intense crimson colouration is developed, which is much more permanent than the violet produced by orcin.

(5.) A portion of the syrupy solution, treated with concentrated hydrochloric acid and potassic chlorate, gave, in twelve hours, a crystalline chloro-derivative. There was not sufficient for analysis.

These experiments convince me that the orcin from Natal aloes is not α orcin; it is probably β orcin, or it may be the next higher homologue.

I very much regret that the small quantity of material operated upon did not yield sufficient of the substance to complete its purification. I hope, however, to confirm my opinion by further experiments and an analysis of the body.

The production of β orcin from a new and available source would possess considerable interest, as at present, in consequence of the uncertainty attending its preparation from usnic acid, from which alone it has hitherto been procured, its chemical history has been only imperfectly traced out.

THE LOGWOOD TEST FOR ALUM IN BREAD.

By JOHN HORSLEY, F.C.S.

MR. DAVIS having, at the conclusion of his paper (CHEMICAL NEWS, vol. xxv., p. 207), invited chemists to give their experience on this subject, I yield to his request, inasmuch as, from having used logwood for several years past, I am in a position to speak of its being *perfectly reliable* if used precisely in the manner I am about to describe. I have on former occasions contributed papers to the CHEMICAL NEWS relative to the detection of alum in bread by the incineration process, but as such analyses occupy a much longer time than is required by law to give notice of proceeding against a baker for adulteration, I was necessitated to search for a short, and at the same time reliable, one. Knowing well that Mr. Hadow's system of using a decoction of logwood was *per se* of little or no value, as iron, copper, and other things produced a similar reaction, it occurred to me to use a tincture of logwood together with a saturated solution of carbonate of ammonia; and after making a variety of experiments with loaves purposely adulterated with different materials, I found that iron was the only substance that clashed with alum in its results, but that even these, when mixed, could easily be distinguished by proper procedure.

Feeling so thoroughly satisfied with this compound test, I placed it in the hands of the police, and with their assistance I surveyed the whole of the county of Gloucester twice, visiting the different bakers' and millers' establishments, and have therefore had some thousands of loaves pass through my hands, and succeeded in obtaining upwards of 200 convictions which it would have been impossible to have done by the incineration process, forty-eight hours being the time allowed to take proceedings in. The last case I had was that of a Herefordshire miller, in 1870. I not only tested the flour and bread made with it in the presence of the magistrates, but actually extracted the alumina by percolation and tested the filtered liquor afterwards, when in each case a deep purple or violet-blue colour was the result. The miller confessed that the flour contained alum, which his men had put in by mistake; and he was accordingly fined fifteen guineas.

At Dr. Carter Moffat's request, I sent him a sample of this alumised flour, and was surprised afterwards to find him stating in his lecture at Glasgow that alum and logwood gave a *dark red*; hence my letter in the CHEMICAL NEWS of September 15, 1871 (vol. xxiv., p. 131), which Mr. Davis now alludes to. I therefore distinctly state that bread containing alum will, in every case, on being treated with logwood in solution, ultimately go blue, it being merely a question of time, although it may take a straw-coloured tinge at first; in conjunction, however, with carbonate of ammonia, the blue colour is more rapidly promoted, which is the beauty of that combination.

As my process was explained and published in the newspapers at the time, perhaps Mr. Davis and others may not have seen it, I therefore now describe it in full.

(1). Make a tincture of logwood by digesting for eight hours 2 drams of freshly-cut logwood chips in 5 ozs. of methylated spirit in a wide-mouthed phial, and filter.

(2). Make a saturated solution of carbonate of ammonia in distilled water.

A teaspoonful of each solution mixed with a wine-glassful of water in a white-ware dish forms a pink-coloured liquid. Bread containing alum, immersed in it for five minutes or so, and stood upon a plate to drain, will in an hour or two go blue on drying; but, if no alum is present, the pink colour fades away. If, on drying, a greenish tinge appears, that is an indication of copper, as carbonate of ammonia produces that colour, but never a blue.

As a counter-check for iron, a piece of the moist blue-coloured bread may be drenched with a few drops of glacial acetic acid, when that containing iron is bleached of a dirty white colour, but with alum a rose-pink or slight buff colour will be observed.

Or it may be tried another way, thus:—Take a piece of the bread in its plain state, and having digested it in dilute acetic acid for an hour or so, press out the liquor and filter; then put in a lump of carbonate of ammonia, and, when all effervescence ceases, add to the clear liquor a few drops of solution of sulphide of potassium or sodium. If iron is present it will be indicated by a dark colour, there being no colour produced with alum; but the addition of a little tincture of logwood immediately reveals it.

I might even go further, and say that if necessary you may quantitatively estimate the alumina thus:—Take, say, ¼ lb. of crumb bread, digest it in a clean basin with some dilute acetic acid, and allow it to stand a few hours; then break up the mass and pass the liquor through a glass percolator, the rim being covered with calico, repeating the percolation two or three times till the liquor is clear. Throw in a lump of carbonate of ammonia to saturation, and add tincture of logwood in excess, when,

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if alum is present, a dark blue colour will be produced, with a flocculent blue precipitate on standing awhile. Collect this precipitate on a filter, wash it off into a dish with dilute nitric acid, and evaporate the red liquor to dryness. Collect the residue in a small Berlin crucible and ignite it at a red heat, when a white powder will be obtained consisting of alumina, with possibly a little lime; treat this with liquor potassæ, to dissolve out the alumina, mix with a little water, filter, and boil with carbonate of ammonia to obtain the pure alumina.

Having now thoroughly exhausted the subject, I trust the perusal of this paper will meet the approval of my readers, and that we shall hear no more of the so-called uncertainty of the logwood test, which I am persuaded is far more reliable than is generally believed; for it seems discreditable to chemistry that there should be such a variety of opinions as to shades of colour, &c.

I entirely agree with Mr. Davis, that potatoes in bread never yield so blue a colour as to be mistaken for that of alum and logwood.

The Laboratory, Cheltenham,
May 6, 1872.

ON THE PRESENCE OF IODATE OF CALCIUM IN SEA-WATER.

By E. SONSTADT.

(Continued from page 196).

In the preliminary note, of which this is a continuation, I stated that the white precipitate formed in sea-water by the addition of a minute proportion of ferrous sulphate was ferrous iodate, but did not give further confirmation of the fact than was derived from the evidence adduced to prove the presence in sea-water of an oxidised compound of iodine, and the similarity between the precipitate produced by ferrous sulphate in sea-water to that produced by the same reagent in a very dilute solution of iodate of calcium. If a very small crystal of ferrous sulphate is dropped into a test-tube containing at least 50 c.c. of sea-water, and the liquid poured off the brown precipitate after a few hours, the addition of a drop or two of hydrochloric acid to the precipitate will cause separation of a trace of iodine, which may be recognised by addition of a drop of carbonic disulphide. When a small crystal of ferrous sulphate is dropped into a beaker containing sea-water, a trail of white clouds of the ferrous iodate shows the path of the crystal, which, however, as it lies on the bottom of the beaker, remains surrounded by clear liquid; but at a distance beyond rings of the iodate form, showing the solubility of the precipitate in excess of the precipitant. After a while, whether the ferrous salt is used in excess or not, a brown, basic, ferric salt separates in flakes, which still retains iodine; and, at least, so far as when one part of ferrous sulphate is taken to ten thousand of the water, and two hours allowed for the reaction, the filtered liquid still retains in solution a trace of undecomposed iodate. Out of the proportions of ferrous sulphate to sea-water tried, three parts to the million were found, under like circumstances, to give the most iodine in the precipitate; but it does not therefore follow that that proportion is a reliable indication of the proportion of iodic acid present, for two parts of ferrous sulphate to the hundred thousand of water gave a result differing from the former by only one-ninth.

The presence of iodic acid in sea-water is further proved by precipitation with chloride of barium; when the precipitation is properly managed, the sulphate of barium carries down with it most of the iodic acid as iodate of barium. The precipitate must be formed in the cold, and but fractionally, the first precipitate being rejected; the best results are obtained when the first precipitate separates so much of the sulphuric acid as to leave just enough behind to give a slight *immediate* cloud with more barium salt. The first precipitate, ten or twelve hours being allowed for its formation before filtering, is perfectly free from iodate. Iodate of barium is slightly soluble in solution of chloride of barium, and therefore the least possible excess of barium salt should be used. The second precipitate, after washing, is boiled with a few c.c. of dilute solution of pure sulphate of potassium. After filtering, iodic acid may be detected in the filtrate by any of the methods in general use, or the filtrate may be evaporated to dryness and ignited at a low red heat, and iodine be detected in the residue by any of the methods applicable to the detection of iodine in an alkaline iodide.

When iodate of calcium is dissolved in dilute hydrochloric acid, a colourless solution is formed, smelling strongly of chlorine. Pure magnesium added to this liquid causes instant separation of iodine, which disappears but very slowly on addition of the reagents in even large excess. This reaction is the most delicate I have met with, for the detection of an iodate by the separation of the iodine in it, and the reaction is more persistent than with other reagents. A centimetre or so of fine pure magnesium wire added to 50 or 100 c.c. of sea-water, acidulated by a few drops of *pure* hydrochloric acid, with addition of a few drops of carbonic disulphide, and shaken up, gives, after a few minutes, a peach-blossom tinge to the disulphide. The reactions described as obtained with carbonic disulphide may be also obtained with starch, though less distinctly, owing to the slower action of the latter upon solutions containing but very little iodine.

It was stated in the first part of this note that sea-water taken before the mouth of the river issuing through Ramsey, and conveying sewage, contained its iodine in a free state. After ten days, however, the whole of the iodine had disappeared, and iodate of calcium was present as usual in sea-water taken some miles out from shore. The reaction of the water was neutral, and, on distilling, it did not, as it had done at first, give off any *trace* of sulphuretted hydrogen, nor any offensive smell. This change in the water took place in a well-stoppered bottle, and there was no indication of any gas having been formed. It was also stated that a specimen of water taken near the shore, at first free from uncombined iodine, contained free iodine after a few days. Organic matter in suspension could be observed in this water. After a few days more, however, the iodine disappeared, and the iodate reappeared, as in the former case. It is probable that the oxidation of iodine in changed sea-water, to iodic acid, takes place by intermediate stages of oxidation. Experiments already made confirm the conclusion arrived at by preceding investigators, that at least one oxide of iodine containing less oxygen than iodic anhydride may be formed, although it be unstable.

It will appear from what precedes that iodine is set free in sea-water wherever rivers, charged with offal and sewage, meet the sea. It would be reasonable to expect to find iodine in the atmosphere about such places. Winds would carry such iodine-charged air along with them, and rain falling while winds were blowing off any extensive areas of iodine volatilisation would contain iodine. Iodine has been found in rain-water, and it has also been sought for and not found. The conditions under which it might be expected to be found are now evident. Recently, a strong wind, accompanied with much rain, blew from the direction of Liverpool Bay (about 80 miles away); the rain-water contained iodine enough to give a recognisable reaction on shaking up 100 c.c. or so with carbonic disulphide. With the wind and rain from other quarters I have either detected no iodine, or had only a suspicion of its presence, the proportion being too small to give a certain reaction.

In my former note there was a curious misprint. In the paragraph describing a method of obtaining iodide of silver by the action of acetate of silver and hydrochloric

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acid on sea-water to which sulphite of sodium had been added, "*sodium* reaction" is put instead of "*iodine* reaction."

(To be continued).

THE DIFFERENCE BETWEEN BENZOLE AND BENZINE.

So much confusion prevails in consequence of the indiscriminate use of the words benzole and benzine, that it may be proper to state what these substances really are, and in what particulars they differ, and in what they are alike.

In the year 1825, Faraday discovered a peculiar liquid in the holders which at that time were used for conveying illuminating gas to private houses in London. He gave to it the name of bicarburet of hydrogen, and published a pretty full account of its properties. Nearly ten years afterwards, the Berlin chemist Mitscherlich produced the same substance from benzoic acid, and in allusion to its origin he proposed the name benzine. Liebig reprinted Mitscherlich's article in his "Annals," and in a foot-note remarks that, as the termination *ine* is too suggestive of strychnine, quinine, &c., bodies with which it has no analogies, it would be better to change the word into benzole, and this he accordingly did. It was thus that the word benzole was first introduced into our language. The French writers adhered to Mitscherlich's original name, and in their dictionaries we find the word benzine, while the English have adopted Liebig's proposition, and speak of benzole. We should have been spared much confusion if Faraday's original name had been retained by all parties.

It will thus be seen that, at the outset, benzole and benzine meant identically the same thing, but after the discovery of petroleum it was observed by chemists that the native rock oil was quite a different substance from the coal-tar product of the gas-house. The various hydrocarbons which can be distilled from petroleum have a different chemical composition, and vary in specific gravity and properties from the coal-tar products. Benzole has a fixed molecular composition; it is a true chemical compound, as much so as alcohol or water; its properties have been fully studied and described, so that on this point no doubts need prevail. On the other hand, the volatile substances which come over during the fractional distillation of petroleum are of a mixed and indefinite character, and it is difficult for chemists to agree upon a definite specific gravity, boiling-point, &c. By degrees it has become customary in the United States to call the liquid which has the sp. gr. of 62° to 65° Baumé (=0·73) benzine; the lighter hydrocarbons are called naphtha, rhigoline, and chymogene; the latter is condensed by pumps and is used for an ice machine. This class of liquids differ considerably from the true benzole of coal-tar; the latter has a sp. gr. of 0·85, and freezes at 37° F. The light oils of petroleum have never been frozen, and their sp. gr. is very low; any product of the distillation of petroleum having so great a sp. gr. as 0·85 (that of benzole) would be too thick to burn in a lamp, and could only be used for lubricating purposes. The solvent properties of benzole and benzine are analogous, though by no means identical; benzole rapidly dissolves asphaltum, while benzine scarcely attacks it; benzole is a better solvent of resins; benzole is far superior to benzine in carburetting air or gas for illuminating purposes. The most marked difference between the two exists in the fact that benzole can be converted by nitric acid into nitrobenzole, and by further treatment into aniline; whereas benzine from petroleum is not thus acted upon, and cannot be employed in the manufacture of aniline colours. Benzine can be readily ignited at a distance, while benzole must have the flame brought a little nearer; although it is volatile at all temperatures, and gives rise to explosive compounds. Benzole costs from six to eight times as much as benzine, according to the state of the market. Nearly all of the benzole of the world is sent to Germany to be there manufactured into aniline, from which are subsequently made the favourite aniline colours. It will thus appear that, although benzine and benzole started into life meaning one and the same thing, they have, in the course of time, come to be two widely different substances. Benzole is made from coal-tar, benzoic acid, and numerous other bodies, and can be converted into aniline. Benzine comes from petroleum, is very light cannot be frozen, and cannot be converted into aniline.

We find that the English, French, and German writers are beginning to recognise this distinction, and it will be better for all parties to agree upon what boiling-point, specific gravity, and chemical formula they will adopt for benzine. Benzole contains about 92·5 per cent carbon, and 7·5 per cent hydrogen; benzine is approximately composed of 84 per cent carbon, and 16 per cent hydrogen. In America, therefore, benzole and benzine mean different bodies of different origin, and having different uses.—*Scientific American.*

NEW RESEARCHES ON THE PHOSPHORUS BASES.*

By A. W. HOFMANN, LL.D., F.R.S.,
Professor of Chemistry in the University of Berlin.

About ten years have elapsed since I have submitted to the Royal Society, partly in conjunction with M. Cahours, a series of papers on the remarkable group of phosphorus compounds, the existence of which was first pointed out by M. Paul Thenard, as far back as 1847. These researches were devoted to the investigation of the *tertiary* and *quartary* derivatives of phosphoretted hydrogen, exclusively accessible by the methods then at our disposal. The study of the *primary* and *secondary* phosphines, the examination of which promised even more noteworthy results than that of the bodies previously investigated, still remained to be achieved.

New tasks of life have since that time presented themselves, and I have not been able to devote myself as much to research as in former days. Nevertheless, numerous attempts were made to procure the primary and secondary phosphines, which were clearly indicated by theory and partly even by M. Thenard's early observations. For a long time, however, these experiments proved unsuccessful, and it was only in the course of last summer that I at last discovered an easy method for their production. I may now fairly hope to complete an inquiry, the first part of which the Royal Society have done me the honour of inserting in the *Philosophical Transactions*; still some time will be required for surveying a field which appears to expand as one advances on its investigation, and I therefore beg leave to present to the Society the results of my inquiries in the measure as they are obtained, even before the whole investigation be terminated.

I. *Formation of Alcohol Phosphines by means of Phosphonium Iodide.*

The starting-point of the new series of researches was a lecture experiment. Wishing to exhibit to my class the decomposition of phosphoretted hydrogen by the spark current of an induction-coil, I was unable to procure by any of the methods hitherto described phosphoretted hydrogen of sufficient purity for this experiment. I was thus led to select a rather unusual substance as a source for phosphoretted hydrogen, viz., the beautiful compound of the latter with hydriodic acid, generally designated as phosphonium iodide. This substance, formerly accessible only with difficulty, may now be easily prepared in any quantity. If a slow stream of water, or better of potash

* A paper read before the Royal Society.

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or soda, be allowed, by means of a dropping tube to flow into a small vessel containing phosphonium iodide, a regular current of perfectly pure phosphoretted hydrogen is evolved, which may alone be introduced into an eudiometer provided with spark wires, and be submitted to experiment. With the first spark that passes, a brown cloud of finely divided phosphorus appears in the eudiometer, lining gradually the inside of the tube. After the lapse of five minutes, two volumes of phosphoretted hydrogen have become expanded into three volumes of pure hydrogen gas.

The facility with which phosphonium iodide is thus seen to split up into its constituents, hydriodic acid and phosphoretted hydrogen, led me to think that this body might be made available for the preparation of the compounds I had so long endeavoured to obtain. Two different processes suggested themselves, both aiming at a reproduction of the conditions under which, as I have shown now more than twenty years ago, the alcohol derivatives of ammonia are readily obtained. For this purpose it was necessary to disengage phosphoretted hydrogen in the presence of an alcohol iodide under pressure. This could be easily accomplished by submitting a mixture of an alcohol iodide and phosphonium iodide in sealed vessels to the action of an agent (such as water or a metallic oxide), zinc oxide for instance slowly decomposing the latter into its constituents. But this process appeared to be capable of a further simplification. Instead of withdrawing the hydriodic acid in the phosphonium iodide from the reaction by means of water or a metallic oxide, it seemed worth trying to utilise the acid in the production of the very alcohol iodide to be acted upon by phosphoretted hydrogen, and the question arose whether this result might not be readily attained by decomposing in so appropriate circumstances the phosphonium iodide by the alcohols themselves.

These several anticipations have been fully confirmed by experiment. Both processes yield alcoholic phosphines easily and copiously; and, remarkably enough, whilst the former (action of alcohol iodide upon phosphonium iodide) gives rise to the formation of exclusively the primary and secondary phosphines I had so long endeavoured to produce, the secondary process (action of the alcohols upon phosphonium iodide) furnishes only the tertiary phosphines and the quartary phosponium compounds previously known, but which may be much more easily and plentifully obtained by the new method. Phosphonium iodide has thus become a general agent for the production of the alcohol derivatives of phosphoretted hydrogen.

The formation of the several groups of phosphines by means of phosphonium iodide is represented by the following equations, in which the reaction is assumed to be accomplished in the methyl series.

Primary Phosphines.

$$2CH_3I + 2(H_3P.HI) + ZnO = = 2[(CH_3)H_2P.HI] + ZnI_2 + H_2O.$$

Secondary Phosphines.

$$2CH_3I + H_3P.HI + ZnO = (CH_3)_2HP.HI + ZnI_2 + H_2O.$$

Tertiary Phosphines.

$$3(CH_3.HO) + H_3P.HI = (CH_3)_3P.HI + 3H_2O.$$

Quartary Phosphonium Compounds.

$$4(CH_3HO) + H_3P.HI = (CH_3)_4PI + 4H_2O.$$

II. *Primary and Secondary Methylic Derivatives of Phosphoretted Hydrogen.*

Owing to the superior interest attached to the monocarbon compounds, I was induced, in the first place, to test the new reactions in the methyl series.

Phosphonium iodide, methylic iodide, and zinc oxide act upon one another with remarkable facility. Two molecules of each of the iodides and 1 molecule of zinc-oxide were found to be appropriate proportions; the ordinary zinc-white of commerce may be employed.

Since it was desirable to procure at once the new compound in sufficient quantity for a thorough examination, the digestion-tubes received considerable charges. If these tubes have a capacity of from 120 to 150 c.c., 70 or 80 grms. of the agents involved in the process may be digested without danger. It is not, however, desirable to pass these limits. The compound first introduced is the phosphonium iodide, then follows the zinc oxide, which is compressed into a solid layer in order to prevent the methyl iodide, lastly poured in, rapidly to come in contact with the phosphonium compound. In the presence of zinc oxide the two iodides act upon each other even at the common temperature; and without this precaution it would be difficult to draw out and seal the tubes. Before heating, the tubes must be strongly agitated in order to produce a thorough mixture of the three substances. As regards the digestion, I have been often satisfied to work at the temperature of boiling water; after six or eight hours' exposure in a water-bath, the transformation is generally complete. If the tubes be heated to 150° in an air-bath, not more than four hours are required. On cooling, the digestion-tubes are found to contain a white crystalline solid; they invariably contain a good deal of compressed gas, so that some precaution is necessary in opening them before the blow-pipe. The gases generally issue with a loud report; explosions, however, are but rarely met with. The proportions of the charges are so selected, that supposing the reaction to be complete, no other products, except methylphosphonium iodide and zinc iodide should be formed. But the presence of some are changed, phosphonium iodide, together with the escape of its constituents, more especially of phosphoretted hydrogen, prove at once that compounds more highly methylated must be formed. Experiment shows, however, that monomethyl and dimethylphosphine exclusively are generated. These two substances are easily separated from the crude product of the reaction, which, by means of a bent wire, may be removed in one piece from the tube.

The separation of monomethylphosphine and dimethylphosphine and the preparation of the two bodies in a state of purity, are based upon the observation that the salts of the former base are easily and thoroughly decomposed by water, whilst those of dimethylphosphine, more especially in the presence of free acid, may be considerably diluted without undergoing any change, but are immediately decomposed by addition of a fixed alkali. The crude product of the reaction is, therefore, consecutively treated with water and strong alkali, the former disengaging the methylphosphine, which, being gaseous, is collected in concentrated hydriodic acid, the latter liberating the dimethylated phosphine, which, being liquid at the common temperature, may be readily condensed by an appropriate cooler. The two bodies being powerfully acted upon by the oxygen of the air, the whole process is to be conducted in an appropriate filter with hydrogen.

Methylphosphine,

$$CH_5P = \left.\begin{matrix} CH_3 \\ H \\ H \end{matrix}\right\} P.$$

Methylphosphine is a colourless transparent liquid of a most overwhelming odour.

Both by cooling and by pressure the gas may be condensed into a colourless liquid floating upon water, and boiling from platinum at $-14°$ under a pressure of 0·7585 metre. The experiment was made with from 60 to 70 grms. of methylphosphine condensed in one operation, the boiling-point remaining constant till the last drop had distilled. In studying the behaviour of the new gas under the influence of increased pressure, I have availed myself of the beautiful compression-apparatus constructed by Gustav Magnus. At 0° 1½ atmospheres were sufficient to start the liquefaction; under a pressure of 2½ atmospheres the gas was perfectly liquid, its purity

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being thus satisfactorily established. At 10° liquefaction commenced, and was completed under a pressure of 2½ and 4 atmospheres respectively. At 20°, lastly, under a pressure of 4 and 4½ atmospheres.

The volume-weight of methylphosphine gas was easily determined by allowing a small tube with a weighed quantity of the iodhydrate to rise into a graduated cylinder filled with mercury and inverted over the mercurial trough and subsequently introducing some concentrated solution of soda, which decomposed the salt. By observing the volume of the gas disengaged, all the data for fixing the volume-weight were given. In this manner the number 24·35 was found, the theoretical value being 24.

Methylphosphine is nearly insoluble in water; if the water contain air, part of the gas disappears, but only in consequence of oxidation, clearly indicated by the formation of white clouds. If the gas stand over water into which air can penetrate from without, the gas after some time is perfectly absorbed. Methylphosphine gas is rather soluble in alcohol even at its ordinary temperature, but more especially at temperatures approaching its point of liquefaction; at 0° one volume of alcohol of 95 per cent absorbs not less than twenty volumes; at the ordinary temperature ether dissolves but little. The solvent power increases, however, rapidly by evolving the liquid. At 0° one volume of ether is capable of dissolving seventy volumes of methylphosphine.

The methylated phosphorus base attracts oxygen with great avidity; on mixing the gas with air, white clouds are formed alone; but detonation does not take place at the common temperature. If methylphosphine be required of absolute purity, the gas must be allowed to escape from the apparatus until a small quantity collected over mercury remains perfectly transparent. The nature of the more immediate products of oxidation remains to be investigated. When gently heated in contact with air, methylphosphine takes fire. A glowing match, and even a glass rod just heated to scarcely visible redness, at once inflames the gas. In contact with chlorine and bromine over nitric vapours, it burns with a brilliant flame.

By its union with acids, methylphosphine gives rise to a series of well-defined salts distinguished by the remarkable property of being decomposed by water. On this property is based the preparation of the body in a state of purity. The salt bleaches vegetable colours like chlorine.

Of the salts, two only have as yet been more closely examined, the chlorhydrate and the iodhydrate.

Chlorhydrate.—If a current of methylphosphine gas be conducted into strong fuming hydrochloric acid, it is perfectly absorbed; no crystals, however, are separated; but on mixing the two gases, they are at once condensed to beautiful, well-formed, four-sided plates. In certain reactions with organic chlorides, which are accomplished in ethereal solution, and which I hope to describe more minutely to the Society hereafter, the salt is disposed in splendid large four-sided tables, which are often a centimetre in diameter. The chlorhydrate is so volatile that it passes over even with the vapour in feathers. Analysis was performed by the methods often adopted for demonstrating the composition of sal-ammoniac in lectures. By allowing equal volumes of methylphosphine and hydrochloric gases to meet over mercury, both entirely disappear with formation of a crystalline deposit. Hence the salts contain $CH_6PCl=(CH_3)N_2P,HCl$. The solution of the chlorhydrate in concentrated hydrochloric acid furnishes with platinum perchloride a beautifully crystallised orange-red platinum salt.

Iodhydrate.—Of all the salts of the base, this is the one most readily obtained; it separates in bulky crystals when a current of methylphosphine is passed into the most concentrated iodhydric acid. If a solution of the gas in somewhat less concentrated iodhydric acid be mixed with ether, the whole liquid solidifies to a mass of iridescent plates. By washing with ether, pressing, and sublimation in a current of dry hydrogen, the salt may be readily obtained in a state of purity. Analysis led to the formula $CH_6PI=(CH_3)H_2P,HI$.

The *sulphate* I have not yet seen in the solid state; it is, however, readily formed by bringing the phosphorus base in contact with concentrated sulphuric acid. The gas is absorbed without the acid colouring. On addition of water, methylphosphine is again liberated. The *sulphite* is a white amorphous mass, which is formed when methylphosphine and sulphurous acid gases are collected together over mercury.

With carbonic acid and sulphuretted hydrogen methylphosphine gas may be mixed without any condensation taking place. Sulphur, carbon bisulphide, and chlorocarbonic ethers, when placed in contact with methyl-phosphine, give rise to the formation of new compounds, which will be the subject of a special communication.

Among the products M. P. Thenard* describes in the short notice of his researches on the "Action of Methylic Chloride upon Calcium Phosphide," is an oily compound boiling at 250° containing C_2H_6P (perhaps phosphoric iodine), which, when treated with water, splits into an acid and a gaseous body. The latter, to which M. P. Thenard assigns the formula CH_4P, is said to combine with either one or two volumes of chlorhydric gas. It can scarcely be doubted that the phosphoretted gas discovered by M. Thenard is the same body, the chemical history of which I have endeavoured to sketch in this paper. There are certainly still some discrepancies to be explained, such as the observations just alluded to, that M. Thenard's equation combined with chlorhydric acid in two proportions.

The somewhat complex reaction which gives rise to the formation of methylphosphine, when generated by means of methylic chloride and calcium phosphide, and, indeed, the difficulties attending the process, which appear to have prevented M. Thenard from pursuing the line of research, have hitherto deterred chemists from entering more thoroughly into the investigation of this remarkable compound. By the method described in this paper, methylphosphine may be readily and abundantly obtained in a state of perfect purity, so that its further examination will present no difficulty.

Dimethylphosphine,

$$C_2IH_2P=\left.\begin{matrix}CH_3\\CH_3\\H\end{matrix}\right\}P.$$

The method of preparing dimethylphosphine has been already stated. It is a transparent colourless liquid, which, when protected from the atmosphere, may be preserved without change. It is lighter than water, in which it is insoluble; alcohol and ether, on the other hand, dissolve it with facility. Its boiling-point is 25°.

Dimethylphosphine is remarkable for the avidity with which it attracts oxygen, and which is infinitely superior to that of the monomethylated base. In contact with the air, it instantaneously takes fire and burns with a powerfully luminous phosphorus flame. If the hydrogen atmosphere in which it is prepared contain only traces of air, the presence of which is at once indicated by the formation of white fumes in working with this compound, even if great care be employed, violent and by no means dangerless explosions are occasionally experienced.

Dimethylphosphine easily unites with acids; all the salts are exceedingly soluble. The solution of the chlorhydrate furnishes with platinum perchloride a fine crystalline salt. The base also unites with sulphur and carbon bisulphide. The compounds thus formed are not yet investigated; but it may even now be remarked that they essentially differ from those produced by trimethylphosphine, more especially in their deportment with carbon bisulphide, a marked discrepancy is observed. Dimethylphosphine in this case produces no crystalline compound similar to those which are formed with the tertiary phosphines; so that the absence of trimethylphosphine among

* *Comptes Rendus*, vol. xxvi., p. 892.

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the products of the action of methyliodide on phosphonium iodide may be readily demonstrated.

The inflammability and the low boiling-point of dimethylphosphine render it difficult to work with this body except in the winter season. The examination of its numerous products of decomposition, which promises to be fruitful in results, is, therefore, as yet but little advanced. Hitherto I have studied somewhat more in detail only the products of oxidation of the methyl bases, which I beg leave to describe to this Society in a special paper.

(To be continued).

THE SUCCESSIVE ACTION OF SODIUM AND IODIDE OF ETHYL ON ACETIC ETHER

CRITICALLY EXAMINED AND INTERPRETED ON THE PRINCIPLES OF THE TYPO-NUCLEUS THEORY.

By OTTO RICHTER, Ph.D.

(Concluded from p. 221.)

PART III.

I SHALL resume the thread of my narrative by dilating on the various species of ketones which are engendered in the destructive distillation of these substances, and briefly explain the nature of the molecular changes which accompany their formation. I shall then endeavour to prove, by a variety of collateral experimental evidence, that the two most conspicuous members of these series, viz., Frankland's ethaceton-carbonic ether and Wanklyn's ethyl-triacetyl, are really constructed upon two distinct chemical types or patterns, and that these differences in constitution are rendered manifest by their general chemical deportment, as well as by the nature of the products of their destructive distillation. I shall finally subjoin a synoptical arrangement of chemical formulæ, exhibiting the genetic relations between Frankland's and Wanklyn's series on the one hand, and the lactyl series on the other hand.

Let us then, in the first place, inquire into the nature of the molecular changes when the baryta salts of these different acetic ether derivatives are subjected to the process of destructive distillation. In Frankland's series, the chief products of the reaction are found to be carbonic acid and a so-called ketone, the composition of which varies with that of the generating baryta salt. In Wanklyn's series, the only substance which appears to have been examined in this respect is the barium-triacetyl, which, on being heated with baryta water, splits up into carbonic acid, acetone, and *ethylic alcohol*, while the corresponding ethaceton-carbonate of baryta furnishes, by the same treatment, carbonic acid and a ketone, but *not a trace of ethylic alcohol*. From this striking and significant fact the conclusion seems to me inevitable, that these two acids are not identical, but isomeric only. Indeed, after examining more closely into these relations, I have come to the conclusion that the presence of alcohol among the products of their destructive distillation is a characteristic feature of Wanklyn's compounds, while the absence of alcohol among these products is a characteristic feature of Frankland's compounds. But in order to comprehend the precise nature of these reactions, it is requisite that I should first of all explain the formation of the ordinary acetone. The principal stages of this process, which requires the co-operation of 2 molecules of acetate of baryta, may be briefly described as consisting—(1) in the re-solution of one of these molecules into peroxide of barium, Ba_2O_4, and oxy-acetyl, $2H_3C_2$; $2C_2O_2$; (2) in the immediate reduction of this peroxide by the oxalic acid of the other molecule of acetate of baryta; (3) in the breaking up of the resulting peroxide of acetyl, $2H_3C_2$; $2C_2O_4$, into 2 molecules of carbonic acid and 1 molecule of methyl, which, by its union with the methyl-adjunct of the aforesaid oxyacetyl, gives rise to 1 molecule of acetone, with the formula $2(H_4C_2 : H_2C_2)$; $2C_2O_2$. Similarly, when ethaceton-carbonate of baryta is distilled with baryta water, it resolves itself, in the first stage, into a molecule of acetate of baryta, which is derived from the colligated deacetylic alcohol, and a molecule of ethacetate of baryta; in the second stage, the ethacetate of baryta breaks up into oxyethacetyl, $2(H_6C_4 : HC_2)$; $2C_2O_2$, and peroxide of barium, which is immediately reduced again by the oxalic acid of the co-operating acetate of baryta, with production of peroxide of acetyl; in the third stage, the peroxide of acetyl splits up into 2 molecules of carbonic acid and 1 molecule of methyl, which instantly unites with the hydrocarbon adjunct of the aforesaid oxyethacetyl, with production of a molecule of ethacetone, whose formula is therefore $2(H_6C_4 : H_2C_2 : H_2C_2)$; $2C_2O_2$. As regards the diethacetone, which is originated in the destructive distillation of the diethaceton-carbonate of baryta, and to which I assign the formula—

$$2(H_6C_4 : H_4C_4 : H_2C_2 : H_2C_2)\,;\,2C_2O_2,$$

its formation is so completely analogous to the former, that the reader will find no difficulty in analysing it for himself. It is worthy of note that these two species of complex ketones are produced by the co-operation of two different acids, one of which contains a simple, and the other a complex, hydrocarbon-adjunct; and my analysis has further revealed the interesting fact that it is the former of these acids which has undergone the process of dissociation. I shall, in the next place, delineate the various stages of the process which accompany the destructive distillation of Wanklyn's barium-triacetyl with baryta water. In the first stage, 1 molecule of hydrate of baryta, after effecting the separation of the deacetylic alcohol, conspires with it in the production of 1 molecule of acetate of baryta, while butyrate of baryta remains. In the second stage, the butyrate splits up into acetite of baryta and deethylic alcohol, whereupon, under the influence of the baryta base, 2 molecules of water become decomposed, the liberated oxygen being employed in the conversion of the acetous acid into acetic acid, while the liberated hydrogen accomplishes the conversion of the deethylic alcohol into ethylic alcohol. In the last stage, the two differently regenerated molecules of acetic acid will then co-operate towards the formation of acetone and carbonic acid, in the manner previously explained. I shall now draw the reader's attention to another set of experiments, from which I expect to gain additional strong evidence in support of my view of the chemical constitution of Wanklyn's ethyl-triacetyl. I shall analyse, for this purpose, an experiment which was devised by Professor Wislicenus, in the hope of transforming Geuther's diacetic ether (Frankland's aceton-carbonic ether) into β oxybutyrate of soda by the combined action of water and sodium amalgam. In this process no hydrogen gas is disengaged, and the resulting products are hydrate of soda, oxybutyrate of soda, and ordinary alcohol, clearly showing that the hydrogen which is liberated in the first stage, according to the equation—

$$2Na_2+4H_2O_2=2(H_2O_2.Na_2O_2)+2H_2,$$

combines directly with the carbon-adjunct of the colligated deacetylic alcohol, with production of acetylic alcohol, that an interchange of metals takes place in the second stage between the sodium nucleus of one of the two newly-formed hydrates of soda, and the ethyl nucleus of the newly-formed oxybutyric ether, the resulting products being alcohol and oxybutyrate of soda. The reader cannot fail to perceive that the oxybutyric acid of Wislicenus, and the butyric acid of Wanklyn, are heterologues of the same family group, and that, with the aid of oxidising agents, it should be possible to obtain the former from the latter. The foregoing experiment is interesting in this respect also, that it illustrates one of the modes of transition from compounds belonging to Frankland's series, to compounds belonging to Wanklyn's series. It is, moreover, worthy of note, that not only hydrogen, but bromine likewise,

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possesses, according to Lippmann, the faculty of combining directly with the aceton-carbonic ether. Now, it is generally admitted that when bromine is made to act on a genuine hydrocarbon-adjunct two molecules of this element invariably enter, the one to take the place of the eliminated hydrogen, the other to unite with it under the form of hydrobromic acid: but what will happen when there is no hydrogen to displace,—in other words, when the hydrocarbon-adjunct is represented by one of the more or less condensed carbon molecules? The answer to this question becomes perfectly intelligible if we assume, that when bromine is simply absorbed by a given organic molecule, it has, like hydrogen, entered into direct chemical union with one of these condensed carbon-adjuncts. Applying this view to the present case, the formula of bibromaceton-carbonic ether will be—

$$\frac{H_2O_2}{2C_4Br_2 ; H_2O_2 : 2H_2C_2 , 2C_2O_2}$$

and it may consequently be regarded as oxybutyric ether, in which the hydrogen of the colligated alcohol has been displaced by bromine. Trusting that the here suggested connection between these two acids will soon form the subject of experimental research, I shall pass on to consider two other equally curious compounds, which Lippmann obtained by the successive action of corrosive sublimate and bromine on sodaceton-carbonic ether. The first of these bodies bears the name, dimercuraceton-carbonic ether, and the second the name, bibromdimercuraceton-carbonic ether. The former compound is produced according to the equation—

$$\frac{H_2O_2}{2C_4 ; H_2O_2 : 2H_2NaC_2 ; 2C_2O_2} + Hg_2Cl_4 = \frac{H_2O_2}{2C_4 ; H_2O_2 : 2HHgC_2 ; 2C_2O_2} + H_2Cl_2 + Na_2Cl_2 ;$$

the first stage consisting in the reduction of the perchloride of mercury to the protochloride by 1 molecule of methylic hydrogen, and the second stage in the reduction of the protochloride to metallic mercury by 1 molecule of methylic sodium, while the liberated mercury unites with the residual formyl-adjunct, making it appear as if 1 molecule of hydrogen and 1 molecule of sodium had been displaced by 1 molecule of mercury only. The latter compound is evidently produced from the former by the direct union of bromine with the condensed carbon adjunct, $2C_2$, and requires no further comment.

Having now completed my inquiry into the genetic relations and chemical constitution of the two series of compounds and derivatives, which the admirable researches of the two great London chemists have brought to light, I have deemed it advisable, for the special consideration of those among my readers who feel disposed to prosecute their chemical studies in the spirit of the "typo-nucleus" theory, to append a synoptical arrangement of chemical formulæ, grouped together in accordance with the combined principles of identity of type and homology. My immediate object is to exhibit the intimate genetic relations which obtain between the members of Frankland's and Wanklyn's series on the one hand, and the members of the lactyl series on the other hand; but in order to render the whole scheme more complete and instructive, I have joined thereto the members of the formyl and glycolyl series also. It is scarcely necessary to remind the reader that the terms formyl, glycolyl, lactyl, &c., terms which are borrowed from the "typo-radical" theory, bear a widely different meaning in the "typo-nucleus" theory. They represent, in fact, the plain or non-enveloped twin-carbon-nuclei, variously modified by the accession of hydrocarbon- or halogen-adjuncts, and each of which, under the combined influence of bases and oxygen, gives rise to three heterologous acids, which seem to be so constituted, as if 1, 3, or 5 univalent oxygen molecules were stored up in the envelope of each single component carbon nucleus. In harmony with the common practice, the water salts of these three heterologues are distinguished from each other by means of different vowels, and, to save space, they are here embodied in the same formula. Thus, for instance, the formite, formate, and formoate of water, are expressed by the collective formula—

$$\frac{H_2O_2}{2H ; 2C_2O_2}.$$

TABLE OF GENETICALLY-RELATED WATER-SALTS.

Formyl Type.

Formyl = $2H ; 2C_2$.

Form-a-te oa	$\frac{H_2O_2}{2H ; 2C_2O_2}$
Acet-a-te oa	$\frac{H_2O_2}{2H_2C_2 ; 2C_2O_2}$
&c.	&c.

Glycolyl Type.

Glycolyl = $2C_2 ; H_2O_2 : 2H ; 2C_2$.

Glycol-a-te oa	$\frac{H_2O_2 \quad H_2O_2}{2C_2 ; H_2O_2 : 2H ; 2C_2O_2}$
Aceglycol-a-te oa	$\frac{H_2O_2 \quad H_2O_2}{2C_2 ; H_2O_2 : 2H_2C_2 ; 2C_2O_2}$
&c.	&c.

Lactyl Type.

Lactyl = $2H_2C_4 ; H_2O_2 : 2H ; 2C_2$.

Lact-a-te oa	$\frac{H_2O_2 \quad H_2O_2}{2H_2C_4 ; H_2O_2 : 2H ; 2C_2O_2}$
Acelact-a-te oa	$\frac{H_2O_2 \quad H_2O_2}{2H_2C_4 ; H_2O_2 : 2H_2C_2 ; 2C_2O_2}$
&c.	&c.

Pyruvyl Type.

Pyruvyl = $2C_4 ; H_2O_2 : 2H ; 2C_2$.

Pyruv-a-te oa	$\frac{H_2O_2 \quad H_2O_2}{2C_4 ; H_2O_2 : 2H ; 2C_2O_2}$
Acepyruv-a-te oa	$\frac{H_2O_2 \quad H_2O_2}{2C_4 ; H_2O_2 : 2H_2C_2 ; 2C_2O_2}$
&c.	&c.

Alconyl Type.

Alconyl = $2H_2C_4 ; H_2O_2 : 2C_4 ; H_2O_2 : 2H ; 2C_2$.

Alcon-a-te oa	$\frac{H_2O_2 \quad H_2O_2 \quad H_2O_2}{2H_2C_4 ; H_2O_2 : 2C_4 ; H_2O_2 : 2H ; 2C_2O_2}$
Acetalcon-a-te oa	$\frac{H_2O_2 \quad H_2O_2 \quad H_2O_2}{2H_2C_4 ; H_2O_2 : 2C_4 ; H_2O_2 : 2H_2C_2 ; 2C_2O_2}$
&c.	&c.

On comparing the formulæ of this table with those of the text, the reader will not fail to perceive that the acelactate of water is identical with Wanklyn's butyrate; the acelactate of water with Wislicenus's β oxybutyrate; the acepyruvate of water with Frankland's aceton-carbonate; and the acetalconate of water with Wanklyn's hydrogen-

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triacetyl. As regards the pyruvate of water, from which the leading type derives its name, its easy conversion into lactate of water by means of nascent hydrogen, furnishes additional strong evidence of the correctness of its formula, which is based upon an analysis of the molecular changes accompanying the destructive distillation of tartaric acid.

I am, of course, ready to admit that several of the compounds enumerated in the preceding scheme have not yet been isolated; nevertheless, when I ponder the great weight and conclusiveness of the experimental evidence which I have been able to bring forward with reference to those which are really known; when it is seen, moreover, that this whole network of chemical formulæ is spun, as it were, out of one thread and woven into a design of high intrinsic beauty and symmetry, I think I may safely affirm, but I do so without boasting, and in all humility, that the critical method of the "typo-nucleus" theory surpasses in its rationality, as well as in its results, the dogmatical method of the "typo-radical" theory. In taking leave of my subject, I feel it my bounden duty thus publicly to express my deep obligations to all those chemists who, even though it was done without their knowledge and consent, have never ceased to supply me with materials for continuing my speculative travels. I can assure these gentlemen, and above all, Professor Frankland and Mr. Wanklyn, that nothing will give me greater satisfaction than to learn that, notwithstanding the antagonism of our present chemical convictions, they have each and all derived a certain amount of intellectual pleasure from my narrative of the adventures of sodium among the acetic ether molecules.

THE HENDERSON PROCESS FOR THE REMOVAL OF PHOSPHORUS FROM IRON.

THE inventor claims that, by this process, phosphorus may, as a rule, be removed from all kinds of British pig-iron that are smelted from ores (as distinguished from cinder pig smelted from common puddling furnace cinder) in sufficient amount to render the iron pure enough for steel. This fact was demonstrated by trials at the Blockhairn Iron Works, in Glasgow. At a trial made on the 23rd December last, No. 4 Dalmellington pig-iron was treated, the analyses of the pig-iron and results as regards phosphorus, by Mr. Edward Riley, are—

Pig-iron, phosphorus per cent	1·14
Refined cast-iron 30 mins. after fusion ..	0·23
,, ,, 40 ,, ,, ..	0·15
,, ,, 50 ,, ,, ..	0·12
Wrought-iron..	0·07
The cinder	0·52

360 lbs. pig-iron, 100 lbs. ilmenite, 10 lbs. manganese, and 42 lbs. of fluoride of calcium were used.

The complete analysis of the cinder is—

	Per cent.
Silica	11·12
Titanic acid	5·02
Protoxide of iron	56·41
Peroxide of iron	18·20
Alumina	1·73
Protoxide of manganese	2·22
Lime	3·51
Magnesia..	0·43
Phosphoric acid	1·19*
Sulphur	0·09
Nickel	trace
	99·92
Metallic iron	56·62

* = 0·52 per cent phosphorus.

The pig-iron smelted from cinder of the above composition will contain all the phosphorus in the cinder, which will be 0·87 per cent in the pig-iron, or 0·27 per cent less than the original pig-iron smelted from ore.

It is obvious that as the phosphorus is not all in the cinder that was removed from the iron, it must have become volatilised. It is worthy of remark that the calcium and manganese have also been volatilised.

We understand that iron (No. 1 or puddled bar rolled direct from bar or bloom as taken from the furnace) made on the 7th inst., in the presence of a committee of scientific men has been tested at Mr. David Kirkaldy's works, and found to stand a higher test than any iron previously examined.

NOTICES OF BOOKS.

Elements of Chemistry; Theoretical and Practical. By WILLIAM ALLEN MILLER, M.D., D.C.L., LL.D., late Professor of Chemistry in King's College, London. Revised by HERBERT MCLEOD, F.C.S., Professor of Experimental Science, Indian Civil Engineering College, Cooper's Hill. Part I.: Chemical Physics. Fifth edition, with additions. London: Longmans and Co., 1872.

IN this new edition of what has long been a standard text-book of chemistry, we find much that had become a necessary addition, owing to the rapid progress made by recent research in some branches of physical science. During the last year solar chemistry, for instance, has visibly developed from day to day; while, since the fourth edition of this work was issued from the press, much has occurred to modify as well as to extend our views of the theory of atomicity. Professor McLeod has been very happy in the selection of his first addition to permanent chemical literature since his acceptance of the chair of experimental science at Cooper's Hill; and is to be congratulated on the manner in which he has fulfilled a difficult task. We must not forget that the later editions had the personal revision of the talented Dr. Miller, and we cannot pass a higher compliment than to say it is difficult to detect, except by direct comparison, where the additions have been made. The work is more than ever entitled to its first rank in the literature of elementary chemical science, and we anticipate the publication of the remaining volumes.

CORRESPONDENCE.

ESTIMATION OF SUPERPHOSPHATE.

To the Editor of the Chemical News.

SIR,—I shall be glad if the following paper should find space in your valuable journal.

I may observe that, being recently associated with the Chemical Society, I addressed it to the President, under the hope that its commercial, if not its scientific, importance, might make it worthy of notice and discussion, but I am politely informed by the Secretary that, as the subject involves no *chemical novelty*, it is not suitable for the Chemical Society. Probably, if this matter gets well before the public, this Society may form a different judgment; if pure and disinterested science will not help us, where are we to look for aid? Fortunately, all matters of sufficient public importance have always a superior power in reserve, and to this, the Press, I now appeal.—I am, &c.,

W. LITTLE.

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To Dr. Frankland, President of the Chemical Society of Great Britain.

On the Important Discrepancy existing between Chemists of repute in the Analysis of the Artificial Manure known as Superphosphate of Lime, for the Determination of the Percentage of Tribasic Phosphate of Lime rendered soluble by Acid, popularly known as "Soluble Phosphate."

Sir,—I hope the question which I bring before the notice of the Members of the Chemical Society through you, as their able and honourable President, besides its great commercial interest, may have sufficient scientific interest to engage their earnest attention.

If I do not mistake the object of the Chemical Society, I should say any large branch of manufacture in which the science of chemistry is much involved, and especially when such manufacture has for its purpose the increase of the food-producing power of agriculture, must be a subject worthy of the serious consideration of the distinguished members of one of the most important of our scientific and learned societies.

Within the last few years Agricultural Associations have done much in dispelling the mystery which for so long had enshrouded the trade, manufacture, and use of artificial manure; the custom is now general amongst farmers acting under the advice of honourable chemists, to purchase these manures for certain well-known and intrinsic qualities, determined by the careful analysis of experienced analytical chemists. Amongst the artificial manures which take pre-eminence before all others, stands superphosphate of lime. The composition of this manure is now well understood by farmers, and a long experience has proved the various ways in which it may be profitably employed; it is manufactured on an immense scale in many parts of Great Britain, the present demand for agriculture probably amounting annually to hundreds of thousands of tons.

In the purchase of this manure by one of the largest and most successful associations in England—the Lincolnshire Farmers' Association—the rule is to purchase by public tender, for ready money, under a guarantee that the manure shall contain, at the time of delivery, 26 per cent of "soluble phosphate;" or, more scientifically, tribasic phosphate of lime rendered soluble by acid, and without reference in any degree to any other matter that may be contained, either as precipitated or insoluble phosphates, &c.; and, in the case of any dispute, it shall be decided by the report and analysis of the chemist for the time being of the Royal Agricultural Society, whose decision shall be final.

It is with reference to the determination of this so-called soluble phosphate by chemists of established repute that agriculture has such just reason to complain: the great discrepancy which exists, not occasionally, *but as a rule*, between eminent analytical chemists leads to so much confusion and misunderstanding, if not to say fraud, that, unless some more stringent and reliable system can be uniformly adopted, the present analytical reports are in a certain degree good for nothing but to promote discord and suits at law.

The following is a recent example of the great discrepancy existing between two chemists, A and B, of established repute; the samples were exactly alike and were sent for analysis at the same time:—

	Sample No. 1, percentage.		Sample No. 2, percentage.	
	A.	B.	A.	B.
Biphosphate of lime, equal to bone phosphate or tribasic phosphate of lime, rendered soluble by acid	20·46	17·64	23·60	19·54
Precipitated phosphate of lime	2·43	—	—	—
Insoluble phosphate of lime	8·10	11·60	8·26	10·70

Hitherto I am inclined to believe that the attention of the purely scientific chemists as a body has not been sufficiently impressed with the scientific and commercial importance of this discrepancy between analysts; but, the fact being known, it is to be hoped some really practical plan will be put into operation to promote a remedy for this scientific scandal and case of agricultural grievance.

The members of our Association are requested to send fair samples of every lot of manure they receive, which are analysed for *soluble phosphate only* by our own local chemist; and occasionally, and always in the case of dispute, samples are sent to the chemist of the Royal Agricultural Society; and as this discrepancy between analysts is a difficulty which has recently cropped up, similar samples are sent to other well-known chemists for the satisfaction of our contractors. And with what result! A difference in their reports, as a rule, of 3 per cent, and sometimes more than 4 per cent, in soluble phosphate, or, in money value, 10s. per ton, a sum small in itself, but when multiplied by 6000, the number of tons of manure distributed by our Association this season, shows an amount of £3000, or 14 per cent on the cost of the manure, and considerably more than what would be a fair manufacturing profit for ready money. But, if all this can occur with an association that uses every kind of vigilance to protect the interests of its members, what must be the consequence with the great body of agriculturists, who, standing alone, have no power to defend themselves against these mischievous discrepancies amongst chemists and *errors* on the part of manure makers. I do not hesitate to say the sum might be expressed by hundreds of thousands of pounds on all the manure used in one year; and whether all this is to come out of the pockets of farmers depends upon the choice of the *high* or *low* analyst as the scientific umpire.

I believe it is not difficult to find a remedy for all this, and, if I may be allowed, I would suggest that samples of superphosphate should be taken by a committee and sent for analysis to a certain number of purely scientific chemists, that the reports sent by these gentlemen should be accompanied with an exact description of the process of analysis employed, and that the scientific committee of chemists, after full consideration, should select that process which should be adopted as a standard for the future guidance for chemists, and by which all commercial disputes and transactions should be settled.

In addition to this question of the discrepancy between analysts, it may be well to refer to another objectionable feature which certain manufacturers and chemists are endeavouring to introduce: I mean what is recently called "precipitated phosphate," and this is done in direct opposition to the advice of the Royal Agricultural Society's chemist, who emphatically tells farmers to *pay only for soluble phosphate*. The following letter, recently received from Dr. Voelcker on this subject, so completely accords with the rule adopted from the commencement by the Lincolnshire Farmers' Association, that I commend it to the earnest attention of chemists and our members.

"Analytical Laboratory, 11, Salisbury Square,
"Fleet Street, London, E.C.
"March 16, 1872.

"Sir,—I have the pleasure of enclosing results of analysis. Your telegram is not quite clear, but I presume you wish me to ascertain what proportion of the insoluble phosphates in the superphosphate occurs as precipitated. This I cannot tell you, for there is no reliable plan of determining the percentage of precipitated phosphates. Precipitated phosphates are insoluble in water, and although more valuable than even insoluble bone phosphate, yet these nice distinctions only serve to encourage doubtful transactions on the part of sharp dealers, and cause confusion in business transactions.

"The business of the manufacture of mineral superphosphates is to render soluble mineral phosphates, and if he performs his work badly and chooses to use cheap materials full of oxide of iron, which causes the portion

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of the soluble phosphates to go back, or, in other words, to become precipitated, he must do so at his own risk. My advice to purchasers of mineral superphosphates is, and always has been, to buy mineral phosphates by the percentage of soluble phosphate at a fixed price per unit, and to take no account of the insoluble phosphates in such superphosphates, and to discard entirely what the maker or dealer may say about precipitated phosphates.

"I do not, as a rule, give any valuation of manures.—Yours faithfully,

"AUGUSTUS VOELCKER."

One other little grievance before I conclude. I protest against analytical chemists taking upon themselves to fix a value to manures. Nothing can be more absurd. Any business man knows that the value must fluctuate with the market price of the materials used, modified also by the process employed, and also by the conditions of purchase; it would be just as reasonable to fix the price of indigo, soap, soda, or any other manufactured commodity; besides, I observe some chemists estimate that "soluble phosphate" is worth four shillings per unit, whilst our Association actually supplies it at nearly half this price, or two shillings per unit or per cent, when the cost of carriage and the value of other materials are deducted.

The committee of the Lincolnshire Farmers' Association have had to contend with many unforeseen difficulties since its formation in 1868, but time, patience, and a firm determination will, I feel confident, soon bring everything into good working order.

In conclusion, I only ask farmers and our members to stick to one another, and always bear in mind our best friends are not to be found outside the circle of the Lincolnshire Farmers' Association.

I am, Sir,
Your obedient servant,
WM. LITTLE.

The Hall, Heckington, Lincolnshire.

THE CHARCOAL RESPIRATOR.

To the Editor of the Chemical News.

SIR,—I am glad to be able to inform you that the charcoal respirators invented by me in 1854 are now coming into general use, especially in manufactories and laboratories. They have been found peculiarly efficacious in protecting workmen from mercurial and other noxious metallic fumes, and have been largely employed for that purpose by the Borneo Company in their quicksilver works at Sarawak, and also by Messrs. Johnson and Matthey. They have also been found very useful in absorbing the fumes of chloride of sulphur so largely used in vulcanising india-rubber, and in stopping hydrochloric acid and sulphurous acid gases, and also the vapours of bromine and iodine.

They do not effectually stop chlorine, but I have recently found that they may be made to do so in the following simple manner:—The respirator is suspended for ten or fifteen minutes over some strong solution of ammonia in a large beaker; in this way the charcoal absorbs a very large amount of ammoniacal gas. It is then taken out and exposed to the air for a short time until the excess of ammonia has been removed, when it will be found that the wearer can remain for a considerable time in an atmosphere containing chlorine without suffering any inconvenience.—I am, &c.,

JOHN STENHOUSE.

The Laboratory, 17, Rodney Street, Pentonville, N.

NOTES AND QUERIES.

Superphosphate of Lime.—I shall be obliged if your readers will kindly inform me of the newest and best books treating of the manufacture of superphosphate of lime, with price and publisher if possible. —OMEGA.

University of Freiberg.—Your correspondent "Undergraduate" inquires as to Freiberg University. As an old Giessen student in the subjects named by your correspondent, I would recommend Freiberg for geology, mineralogy, chemistry, especially if allied with metallurgy. Giessen has much to recommend it: Professor Will, in the chair of Chemistry, being noted for the personal care he bestows on each student, an advantage of smaller universities over such as Berlin, Heidelberg, or Leipzig. The terms, I believe, in all the German universities begin about the second week in October, and in the winter session the courses begin at the rudiments of inorganic chemistry, not organic, and soon in other subjects. Personal prejudice would lead me to recommend Giessen; its collateral advantages, especially to a foreigner, are great. If "Undergraduate" wants more information I shall be happy to afford it to him, and I enclose my private address.—J. F. A., F.C.S.

MEETINGS FOR THE WEEK.

MONDAY, May 20th.—Anthropological, 8.
TUESDAY, 21st.—Civil Engineers, 8.
—— Royal Institution, 3. E. B. Tylor, F.R.S., "On the Development of Belief and Custom amongst the Lower Races of Mankind."
—— Zoological, 9.
WEDNESDAY, 22nd.—Society of Arts, 8.
Geological, 8.
THURSDAY, 23rd.—Philosophical Club, 6.
—— London Institution, 7.30.
Royal Institution, 3. Dr. Tyndall, LL.D., F.R.S. "On Heat and Light."
FRIDAY, 24th.—Royal Institution, 9. Prof. Clifford, "On Babbage's Calculating Machine."
—— Quekett Microscopical Club, 8.
SATURDAY, 25th.—Royal Institution, 3. Prof. Roscoe, F.R.S., "On the Chemical Action of Light."

TO CORRESPONDENTS.

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C. T. Kingzett, Dr. W. H. Taylor, and F. A. Paget.—Received with thanks.

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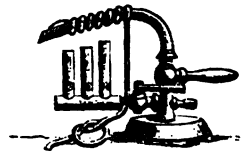

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THE CHEMICAL NEWS.

VOL. XXV. No. 652.

ON THE PRESENCE OF IODATE OF CALCIUM IN SEA-WATER.

By E. SONSTADT.

(Concluded from page 232).

THE experiments now to be described were made upon water kindly procured for me by my friend, Mr. Spanton, from Ramsey Bay, at a distance of about three miles from the shore. The sp. gr. of the water was 1·0265 at 13°. A number of attempts were made to distil off the iodine from quantities of from 400 to 600 c.c. of the sea-water, after addition of reagents intended to set the iodine free. It was not found possible to obtain in this way more than a small fraction of the iodine present. Such is the activity of this wonderful element when in the free state in a large proportion of water, and in contact with anything capable of acting either as an oxidiser or a reducer, that it seems impossible to retain it for any time in its free state. Bromine, on the other hand, may very readily be distilled off sea-water; and if I had occasion to estimate this element in the water, I would begin by distilling it off, after adding a suitable reagent, rather than by the usual way of fractional precipitation, which latter process, owing to the solubility of bromide (as well as of iodide) of silver, in strong solution of chloride of sodium, can scarcely be expected to yield accurate results.

Were it not for the interfering action of other compounds, and particularly of ferric oxide, in sea-water, the iodine might be estimated very closely by simply setting it free and ascertaining its amount by any suitable process. In practice, only about half the iodine present can thus be estimated, since the ferric oxide present assists in the reaction.

It seems advisable, however, to pause here a moment, and consider how a quantitative estimation can be made of the iodine in a solution which at best gives a reaction only just distinctly recognisable to a trained eye. When carbonic disulphide is shaken up with a solution of iodine in pure water, the proportion of iodine taken up by the disulphide is such as to balance the affinities of the iodine between the water and the disulphide. If to the iodine solution a salt is added which increases the affinity of that solution for iodine, then a less proportion of iodine is taken up by the disulphide. The proportion of iodine abstracted from any solution by disulphide depends, firstly, upon the relative solubilities of iodine in the two liquids, and, secondly, upon the proportion of disulphide used to the quantity of liquid taken for experiment. That this is so may be easily seen by shaking up disulphide with any liquid (such as a strong solution of iodide of potassium containing free iodine) having an affinity for iodine approaching to that of carbonic disulphide. Hence it is that the iodine colour reaction is most delicate when the solubility of iodine in the solution acted upon is lessened in any way, as by cold. Sea-water can dissolve more iodine than pure water, and therefore starch or carbonic disulphide become less intensely coloured by a proportion of iodine set free in sea-water than by the some proportion set free in pure water. Nevertheless, the conditions being the same, the quantity of iodine actually in a free state in two instances being equal, the same proportion of any decolourising agent will be needed in both cases, although in the one the disulphide may be intensely coloured, and in the other only faintly tinged. It is, however, in the latter case, desirable to add the decolourising agent in such manner as to act upon the iodine retained by the liquid earlier than upon the iodine retained by the disulphide. It is therefore possible (and that it is so has been experimentally abundantly confirmed) to obtain quantitative results of nearly, or quite, equal accuracy when a given proportion of iodine in a liquid imparts a faint tinge only, as when it imparts a strong colouration to the disulphide used.

When sea-water is concentrated, even under conditions that effectually prevent any decomposition taking place of the iodate it contains, a soluble barium salt throws down less iodic acid than it does from the unconcentrated water. The loss arising from the increased solubility of the iodate of barium, owing to the accumulation of common salt in the liquid, exceeds any gain obtained by acting upon a less bulk of liquid. The same is true when hydriodic acid is formed from the iodic acid in sea-water, a silver salt added, and the liquid evaporated. Water, added to the dry residue in quantity sufficient to dissolve the chloride of sodium, takes up all the iodide of silver. If weak alcohol is used to dissolve out the chloride of sodium, and the whole filtered, only a trace of iodide of silver remains upon the filter. Indeed, iodide of silver is not quite insoluble in alcohol, although the alcoholic solution is not strong enough to be precipitable by water. If the residue is dissolved in hydrochloric acid, which must necessarily be used somewhat dilute, the result is much lower than when the unconcentrated water is used. But when sea-water, the iodate in which has been decomposed by addition of a solution of, say, arsenious anhydride in hydrochloric acid, and evaporated with addition of sulphate of copper, the residue dissolved in the least possible quantity of water, and the solution filtered, the iodine remains on the filter as cuprous iodide, and its amount may be estimated by gently igniting the filter with a little hydrate of sodium, taking up the iodide of sodium with water, filtering, and estimating the iodine in the filtrate, after acidulating with dilute *sulphuric* acid, by chlorine water and carbonic disulphide.

It might be perhaps imagined that to evaporate a liquid containing an iodide with hydrochloric acid would occasion loss of hydriodic acid or of iodine. Hydrochloric acid may be boiled for days together over iodide of silver without in the least degree decomposing that salt. Hydriodic acid, boiled with an alkaline chloride, will, if used in excess, expel nearly all the hydrochloric acid; but, when the solution gets very much concentrated, some iodine is separated and lost. Nevertheless, practically, chlorides may be converted into iodides by boiling with hydriodic acid in excess, and this probably because the boiling-point of hydriodic acid is higher than that of hydrochloric acid. Hence, the less soluble iodides may be evaporated to dryness with hydrochloric acid without much, if any, loss; and experience has not enabled me to detect any loss in such cases—so far, at least, as relates to the iodides of silver and of copper produced in sea-water as described. The only appreciable source of loss arises from the solvent action of the solution of chloride of sodium on the precipitates, which, in the case of cuprous iodide, appears to be very slight.

The five following quantitative experiments were consecutive, and are given in the order in which they were made; I mean that they are not picked out of a series, but taken as they came. The precipitates were all treated as has just been described. The chlorine water used was very dilute, and did not vary in strength by so much as 1 per cent daily; it was delivered out of a narrow-necked flask by a piece of quill tube drawn out at one end, and the quantity delivered ascertained by weighing the flask and its contents (including the tube) before and after each experiment. The chlorine water was standardised by testing with weighed portions of solution of pure iodide of potassium. Each experiment involved four weighings, except such as were made in quick succession, when it sufficed to ascertain the weight of the chlorine water used. By proceeding thus, all possibility of the results of the experiments being influenced by unconscious bias was

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prevented. 200 c.c. of water were taken for each experiment, except for (4), which had 400. For uniformity's sake, the results are given in each case for 100 c.c., and the iodine is stated as iodide of potassium.

(1).	100 c.c.	sea-water	0·000229 KI.
(2).	,,	,,	0·000203 ,,
(3).	,,	,,	0·000236 ,,
(4).	,,	,,	0·000330 ,,
(5).	,,	,,	0·000277 ,,

(1). 200 c.c. of water evaporated, after addition of a c.c. or two of hydrochloric acid and a decigramme or two of hyposulphite of sodium, to about a fourth. Filtered off sulphur, and added to filtrate solution of a few milligrammes of sulphate of copper. Slightly supersaturated with NH_3, and filtered after an hour or two.

(2). 200 c.c. of water. Did not evaporate. Added c.c. or two of solution of arsenious anhydride in hydrochloric acid, then sulphate of copper as in (1). Rendered just alkaline by ammonia, and filtered after a while.

(3). 200 c.c. Solution AsO_3 in HCl added as in (2); also copper solution. Evaporated to dryness, and *dried strongly*. Took up with water and filtered.

(4). 400 c.c. As (3), but less strongly dried.

(5). 200 c.c. Added hydrochloric solution of arsenious anhydride, then about 50 c.c. of strong HCl acid, and acetate of silver until a slight permanent opalescence was produced. Filtered after some hours.

It will be observed that, in three out of these five experiments, the water was not concentrated.

The copper and silver processes may be thus compared:—

Copper Process.		*Silver Process.*	
Without concentration (2)	203	Without concentration (5)	277
With evaporation to dryness (4)	330	With evaporation to one-fourth (6).. ..	170

Experiment (6) was not consecutive with the other five experiments, and is introduced only to illustrate the relative value of the two processes. Thus it appears that the silver and hydrochloric acid process is rather better than the copper process when the water is not evaporated; and that the copper process is greatly superior to its rival when the water is concentrated, and still more so when a dry residue is obtained.

Experiment (4), which gave the highest result, is probably very near, and not over, the truth; for, in such experiments as these, loss arising from a partial solution of the precipitates is unavoidable. I take, therefore, 33-100ths of a milligramme of iodide of potassium as representing the iodine present in 100 c.c., or 102·7 grms., of sea-water. This gives just one part of iodate of calcium in 250,000 parts by weight of sea-water. A cubic mile of sea-water therefore contains about 17,000 tons of iodate of calcium, or 11,072 tons of iodine.

One hundred million parts of sea-water are here estimated to contain four hundred of iodate of calcium; this is a little over two atoms in units. It seems at least remarkable that most of the constituents of sea-water, so far as these are quantitatively known, approach to a definite integral numerical ratio when compared according to their atomic weights. A glance at Thorpe and Morton's paper "On the Composition of the Water of the Irish Sea," or, probably, at any other elaborate analyses of sea-water, will show that the proportion of the constituents to one another hints at such a law. Nor let this be too carelessly condemned as fanciful. If the crust of the earth (excluding from consideration such partly mechanical mixtures as the Neptunic rocks, which are also derived rocks) consists of a mixture of an indefinite number of minerals of definite chemical constitution, then the aggregate constituents must have to one another a relation referable to the atomic weight of each; and if the soluble constituents were dissolved out so as to fairly "sample" the whole, and the water acting as such solvent were not liable to the segregating influence of force derived from life, then we should necessarily find the proportions of the elements in sea-water exactly adjusted to this law of atomic weights. If this view should gain strength from further investigations, however, it would become necessary to re-consider the modern theory respecting the power of isomorphous substances to replace one another in a definitely constituted mineral, in indefinite or anomalous proportions. It seems very desirable, from this point of view, that quantitative determinations should be made of, for instance, the lithium, the phosphoric acid, the strontium and barium, the presence of which in sea-water may be so easily detected.

I trust I may be excused by my older chemical readers the liberty I take of adding, in concluding this note, some remarks respecting the use of nitrate of silver in the analysis of salts containing chlorine, bromine, and iodine. If the solutions used are *perfectly neutral*, iodine and bromine are not set free; but the *slightest* acidity of the solutions determines the speedy liberation of chlorine, which, as it comes, decomposes, first the iodide of silver, and, the proportions being suitable, also bromide of silver. In other words, iodine and bromine are liberated, and, so far as chlorine is formed to effect this liberation, they are lost to the result. If the analyses of the bromine in sea-water have been made in acid solutions by nitrate of silver, another source of loss, besides that pointed out in a preceding paragraph, has been imported into the analyses.

That chlorine decomposes iodide and bromide of silver, in whatever conditions these salts may be, is very well known. Yet nitrate of silver is directed to be used in such analyses, and I have not met with any warning respecting the necessity of working with perfectly neutral or alkaline solutions. There is no such objection to the use of acetate of silver, which is also in every way a more convenient reagent, and it is very stable.

PRELIMINARY NOTE ON OZONE.

By CHARLES THOMAS KINGZETT.

Houzeau found that the oxygen evolved by treating baric peroxide with hydric sulphate contained an agent possessing the properties of ozone—that is to say, it liberated iodine from potassic iodide, and was capable of oxidising ammonia. I am not *aware* of any experiments in the same direction upon oxygen derived from other sources.

Whilst experimenting upon ozone, I was desirous of ascertaining if oxygen from all sources possessed the properties ascribed to that obtained from baric peroxide and hydric sulphate; therefore I made the subject a matter of experiment, and obtained amongst my results the following:—

Oxygen obtained by either—

(*a*). Heating mercuric oxide, and passing the resulting gas through strong and pure potassic hydrate (to absorb any nitrous fumes);

(*b*). Acting upon potassic dichromate with hydric sulphate;

(*c*). Acting upon potassic permanganate with hydric sulphate; or,

(*d*). Heating *native* or *artificial* manganic dioxide;—

liberated iodine from potassic iodide, forming, when starch was present, the blue iodide. In short, from every source I have tried, the oxygen produced never lacked these properties. Of course contact of the gas examined with organic matter was avoided as far as possible.

Thus in (*a*), the tube containing the mercuric peroxide was drawn out, and bent twice at right angles, and then

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passed into a tube holding the potassic hydrate, the column depth of which was in every experiment more than four inches. (*b*) and (*c*) are readily performed in open test-tubes, placing at the mouths of the tubes the paper soaked in the potassic iodide and starch mixture.

But acting upon potassic permanganate with hydric sulphate requires care for (as is well known) if the mixture be heated, vapours of permanganic acid are evolved and detonations occur. I purposely obtained these detonations twice by placing the tubes containing the mixture in a steam-bath. The contents of the tubes smelt strongly of ozone afterwards, just like the fishy odour obtained by the passage of electric sparks through moist air or oxygen; and on holding a piece of iodide paper over the mouths of the tubes, iodine was rapidly liberated.

In (*d*), the manganic dioxide may be heated to bright redness, and yet the vapours evolved contain, or in some way produce, the agent alluded to before. This is remarkable considering that ozone is destroyed instantaneously at 300° C., and slowly at much lower temperatures. However, at present, I have no proof to offer that it *is* ozone; the moisture on the iodide paper may share in the reactions which occur.

. I have ventured these statements in the belief that the facts stated are not *generally*, if at *all*, known. If they are known, my experiments merely confirm them, and if they are not known and explained, I hope to be able to show by a series of experiments which I am now making not only the effects but also the causes.

St. Ann's, St. Helen's, Lancashire.
May 14, 1872.

ON IMPROVING THE QUALITY OF IRON BY MEANS OF MECHANICAL PUDDLING.*

By FREDERICK A. PAGET, C.E.

PERHAPS the most important truth which has been lately elicited touching mechanical puddling is its effect in improving the quality of the puddled bar. Mr. Danks has worked up almost every kind of American and British pig metal with excellent results as to quality. Mr. Adam Spencer has in his revolving furnace produced excellent iron from Middlesborough metal containing 2 per cent of phosphorus. As already noticed, experience with oscillating rabbles points to more or less improvement in the quality. Mr. Hutchinson, as we have seen, improved the quality of Cleveland iron with his revolving rabble. M. Dormoy has puddled with success some old cannon-balls the Turks left behind them at Temesvar, in Hungary, so white, and containing such a large quantity of arsenic as to be utterly intractable by the ordinary process; he has also operated at Zeltweg, in Styria, upon pig metal alloyed with copper and sulphur; upon the sulphurous pig metal of the Loire and that of the Moselle—the latter containing very large percentages of phosphorus. In every case perfectly tough iron and steel, often rolled into the most difficult special shapes, have been produced. It is clear to the eye of the mechanic that all these otherwise very differing apparatus are alike in one particular—that of more or less thoroughly stirring up the first broken, then molten, and lastly pasty, metal, together with the fettling on the bed. The infinite variety of chemical conditions formed by the different kinds of pig and fettling, under which these results have been obtained in England, the United States, in France, Styria, Hungary, and Austria, clearly debar us from searching for any recondite chemical cause; and it is evident that, whether this thorough stirring be obtained by exhausting manual labour, or by an imperfect oscillating rabble, or by a revolving bed, or by a revolving rabble, the mechanical effect must be the same. That is to say, the molten cast-iron has to be continuously stirred up in order, in the common furnace, to expose it to the oxygen entering at the door, and contained in the fettling; in Mr. Danks's and Mr. Spencer's furnaces to the oxygen in the latter only.

There thus seems to be three principal reasons why mechanical puddling, or, in other words, good puddling, produces such good iron. The operation is (1) completely carried out; (2) the puddled bar is really homogeneous; (3) the multiplication of the surfaces of contact intensifies the purifying chemical reactions.

1. Very good iron is of course often produced by hand puddling; but it is a labour clearly beyond human strength required to be continuously exerted—day by day, and night after night—for years. In hand puddling there is hence notoriously a liability in the "underhands" shirking their arduous work, and producing bad iron. Mr. Menelaus, of Dowlais, has, in fact, publicly stated that in hand puddling "it was often found that portions of badly-puddled iron have been wrapped up in the ball by the puddler." This statement may be said to have been long ago distinctly proved by a process that underwent a thorough trial. Mr. Davis, of the Low Furness Iron and Steel Works, proceeded in the belief that an ordinary puddled ball really consists of a mixture of good and completely converted iron with "raw," or only partially converted, iron. On crushing such balls, when cold, under stamps, and grinding the pieces between rolls, they separated themselves into two distinct sorts, namely, lumps of wrought-iron originally embedded in, so to say, husks of white pig-iron. By re-heating and working up the portions thus demonstrated to be wrought-iron, excellent blooms were produced; but the plan did not answer financially.

2. An assumption that the lumps of pig metal as usually charged into the puddling furnace could produce homogeneous iron without some stirring up could only be based on the supposition that they were all similar in chemical composition and specific gravity. When, for instance, copper and tin are melted together to form brass, unless they are stirred up while being fused and run out, the metals separate, and arrange themselves according to their densities; and this action in the case of pig metal would only take place in a somewhat less degree on account of the slighter divergences between the different portions. As a matter of fact, "fined" iron does tend to rise to the top.

3. Few facts connected with metallurgy are more certain than that, while the carbon and silicon are easily oxidised out of pig metal, this is not the case with phosphorus and sulphur, the first rendering the iron cold-short, and the second red-short. Mr. Parry considers "that the effect of puddling is to reduce the quantity of sulphur to about one-third, and of phosphorus from one-fourth to one-fifth of that originally contained in the pig-iron." Mr. I. Lowthian Bell is of opinion that nine-tenths of the phosphorus are expelled in puddling. It is only reasonable to conclude that this beneficial effect increases with good hand puddling, and rises in proportion with the thoroughness only obtainable by a steam-propelled rabble. The reactions between the metal and the fettling must be intensified by the increase of contact surfaces afforded. To take an instance. Black oxide of manganese was in 1835 advocated by Scharrhäutl, and his recommendation has been confirmed by Caron's analyses, as an agent for taking up at least the sulphur. The difficulty attending it, however, consists in its not being fusible, and hence able to come into intimate contact with the iron. The powerful agitation afforded by the revolving rabble would, it is evident, just afford these large surfaces of contact. But without the use of more or less expensive "physic," it may be relied upon that inferior pig metal, thoroughly beaten up by this simple tool, will produce better iron, by at least 5s. per ton, than when the unaided and easily-fatigued human arm is employed.

* From a paper "On the use of a Revolving Rabble in the Common Puddling Furnace."

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THE PREPARATION OF CHRYSAMMIC ACID AND CHRYSAMMATES.

By WILLIAM A. TILDEN, D.Sc. Lond.

These beautiful compounds are usually prepared from aloes, but the soluble extractive matters which constitute at least half of the crude drug, yield little but picric and oxalic acids, and the resinoid gives a mere trifle of chrysammic acid.

I find it preferable, therefore, to employ for the manufacture of aloetic and chrysammic acids the aloin of Barbadoes aloes, which, since the discovery of Flückiger's "nataloin" would be appropriately named *barbaloin*. The following is an outline of the process I adopt. Fine Barbadoes aloes must be selected; and the variety which has a rich brown, not dark, colour and powerful odour, yields the best result. One part of such aloes is dissolved by agitation with seven or eight parts of boiling water, slightly acidulated with hydrochloric acid. The solution is allowed to cool and to remain at rest for twenty-four hours, when it may be strained to remove the deposited resin. It is then evaporated down in an open dish till a syrupy consistence is attained, and there remains rather less than two parts of liquid. This set aside for a day or two solidifies in consequence of the formation of a mass of granular crystals. The whole is drained in a calico bag, and then submitted to gradually increasing pressure till entirely free from the black mother-liquor. In this way a lemon-yellow mass of barbaloin results, which amounts to from 20 to 25 per cent of the aloes if a proper selection has been made. To render it quite pure, it requires one or two crystallisations from rectified spirit, but for the preparation of chrysammic acid this is unnecessary. It has only to be dried and powdered and introduced in small portions into about six times its weight of fuming nitric acid (sp. gr. 1·45), kept cool. After standing a few hours, about half its volume of water is added and heat applied until, in consequence of the formation of deposit, the liquid bumps. During this digestion a considerable quantity of carbonic anhydride escapes with the nitrous fumes. A further quantity of water is then added, and when cold the bright yellow crystalline deposit of aloetic and chrysammic acids filtered off. The liquid retains oxalic and picric acids, together with a small quantity of aloetic acid, which may be recovered by distilling away the nitric acid and washing the residue with water. The mixture of aloetic and chrysammic acids thus obtained is dried and boiled gently for eight or ten hours with sufficient nitric acid to cover it. Water is again added, and the crystalline precipitate collected and washed till the washings become pink. It is then boiled for an hour with about an equal weight of potassic acetate dissolved in fifty parts of water. The solution thus obtained deposits on standing a copious crystallisation of green sparkling potassic chrysammate, which may be washed with a little cold water. The mother-liquors, which retain potassic aloetate, are evaporated down, acidified by nitric acid, and the aloetic acid converted into chrysammic acid by further treatment with nitric acid, as already described.

Proceeding in this way, barbaloin readily yields more than a third of its weight of pure potassic chrysammate.

Chrysammic Acid.—Crystals of chrysammic acid are best obtained by dissolving potassic chrysammate in a considerable quantity of boiling water, and strongly acidifying the liquid with acetic acid. Thin yellow fern-leaves, a quarter of an inch long, mixed with a few long red crystals, are deposited in a few hours. On warming the whole gently, the latter are re-dissolved, and the yellow fern-leaves, which are mixed with a few much smaller tables, may be filtered off and washed. They consist of pure chrysammic acid; in mass they strongly resemble picric acid, but are more lustrous.

After exposure to dry air at ordinary temperatures for a few days, they suffer no loss of weight by heating to 150° C. Evaporated with pure sulphuric acid, they leave no residue.

Lead Chrysammate.—Described by Schunck and Mulder as a red powder containing variable proportions of lead. It may easily be obtained, however, beautifully crystallised, by mixing a boiling solution of potassic chrysammate with a slight excess of plumbic acetate dissolved in boiling-water and acidified with acetic acid. On cooling, long thin prisms, exhibiting a magnificent bronze reflection, are formed. The light transmitted by the crystals is pale red and strongly polarised, so that on viewing, by means of a lens, some of them suspended in the mother-liquor, the light is seen to be completely cut off when two of them cross each other at right angles. Mounted properly, they form a pretty microscopic object.

The salt was found to have the formula—

$$C_{14}H_2Pb''(NO_2)_4O_4{\cdot}4H_2O.$$

	Theory.	Experiment.
Pb	29·69	28·92
H_2O	10·33	10·18

Barium Chrysammate.—Hitherto described as a red powder. Obtained in the crystalline form by mixing boiling solutions of potassic chrysammate and barium chloride acidified with acetic acid. It appears to be one of the most insoluble of the chrysammates, as the mother-liquors left after the crystallisation of the salt are almost colourless. It forms brown shining needles, which, however, present none of the green or golden lustre so noticeable in most of the other salts.

The formula seems to be the same as that assigned by Mulder to the uncrystallised compound, viz.:—

$$C_{14}H_2Ba''(NO_2)_4O_42H_2O.$$

	Theory.	Experiment.
Ba	23·18	22·77

Potassium Chrysammate crystallises in two forms—usually as dark red spangles with bright green lustre, or when the salt is crystallised quickly, or from a slightly acid solution, as bright crimson needles with slight golden reflection. The red crystals have the formula—

$$C_{14}H_2K_2(NO_2)_4O_4{\cdot}3H_2O.$$

	Theory.	Experiment.
H_2O	9·81	9·09

The formulæ used in this paper are double those hitherto employed for chrysammic acid and its compounds, and are in accordance with the view of Græbe and Liebermann, who represent chrysammic acid as a derivative of anthrachinon. On this supposition it must be a dibasic acid, and I have therefore made some attempts to prepare some salts, the constitution of which might help to decide this question. At present, however, I have not been successful in producing acid or double salts presenting characters such as would entitle them to be pronounced definite compounds.—*Pharmaceutical Journal.*

THE HENDERSON PROCESS FOR THE REMOVAL OF PHOSPHORUS FROM IRON.

Last week, in referring to experimental trials of this process, we stated that iron had been made in the presence of a committee of scientific men, and tested at Mr. David Kirkaldy's works. Through the courtesy of the inventor of the process we are now able to publish Mr. Kirkaldy's certificate of the tests, which will, we are sure, excite great interest.

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RESULTS OF EXPERIMENTS TO ASCERTAIN THE ELASTIC AND ULTIMATE TENSILE STRENGTH, &c., OF ONE PIECE OF BILLET-BAR AND ONE PIECE OF PLATE RECEIVED FROM MILLWALL IRON WORKS.

Test No.	Description.	Stress. Elastic, per square inch.	Stress. Ultimate, per square inch.	Ratio of Elastic to Ultimate.	Contraction of Area at Fracture.	Stress per sq. inch of Fractured Area.	Extension in 5 ins. At 40,000 lbs. per sq. in.	Extension in 5 ins. Ultimate.	Appearance of Fracture.
G.		lbs.	lbs.	per cent.	per cent.	lbs.	per cent.	per cent.	
1634	Bar, as rolled	23,400	56,735	41·2	37·8	91,213	3·60	29·4	Fibrous.
1635	Bar, heated and cooled in water	39,300	76,980	51·1	6·7	82,508	0·22	6·2	95 per cent, crystalline, fine.
*1636	Plate, as rolled	29,800	54,788	54·4	21·7	69,985	2·04	12·2	Fibrous.
*1637	,, ,, ...	28,900	53,196	54·3	18·7	65,405	3·76	15·6	Ditto, irregular.

* No. 1636 cut off at right angles to 1637.

"I hereby certify that the above bar and plate were made at the Millwall Iron Works (Messrs. Joshua Jeavons and Co.) on the 7th of May, 1872, by the Henderson process, and witnessed by several gentlemen. That the charge consisted of 448 lbs. of grey Cleveland pig-iron, brand 'Clarence,' 152 lbs. of ilmenite, and 56 lbs. of fluor spar. Two balls were formed by puddler, shingled under steam-hammer, heated in furnace, and then rolled, one of the balls into a billet-bar $1\frac{1}{4}'' \times 1\frac{1}{4}''$, the other into a plate $\frac{1}{4}''$ thick, and that both were stamped with my die for subsequent identification.

"I also witnessed a second charge, consisting of 448 lbs. of the same pig-iron ('Clarence'), 56 lbs. of fluor spar, and 56 lbs. of burnt brick, formed into three balls, and shingled; but, owing to some misunderstanding, were not heated in time for rolling before I left the works at 9.40 p.m.

"To James Henderson, Esq., of New York, Tavistock Hotel, Covent Garden, W.C.

"DAVID KIRKALDY.

"The Grove, Southwark Street, London, S.E.,
"May 21, 1872."

NEW RESEARCHES ON THE PHOSPHORUS BASES.*

By A. W. HOFMANN, LL.D., F.R.S.,
Professor of Chemistry in the University of Berlin.

(Continued from p. 235.)

III. *Products of Oxidation of the Phosphines of the Methyl Series.*

WHEN determining phosphorus in several substances which, in the course of the new researches on the phosphines, had to be examined, it was found that these bodies, and especially the members of the methyl series, resist with remarkable energy the action of oxidising agents.

If the bodies were heated according to Carius's method, it happened sometimes, when the digestion in sealed tubes was conducted according to the earlier directions with a nitric acid not perfectly concentrated and at moderate temperatures, that the liquid taken from the tube and treated in an appropriate manner with magnesian salts gave no precipitate whatever. If, on the other hand, strongest fuming nitric acid be employed at very high temperatures, phosphoric acid is certainly formed; but only when the reaction takes place at the very extreme temperatures recommended by Carius† in his more recent paper is the whole quantity of phosphorus made precipitable by magnesium salt.

It appeared of interest to submit to a closer examination the products of oxidation that are formed by the action at moderate temperatures of nitric acid on the primary and secondary phosphines, some of which have probably passed already through the hands of M. Paul Thenard when engaged in his remarkable, but unfortunately unfinished, researches on this subject. Experiment showed that under these circumstances new acids of great stability and comparatively little volatility are formed, and a very simple method of estimating phosphorus in this whole group of compounds at once suggested itself. It was only necessary to dissolve the substance under examination, according to circumstances, either in strong hydrochloric or nitric acids, to mix the liquid slowly with fuming nitric acid, to treat the solution after evaporation with excess of sodium carbonate, and finally to dry and fuse the mass in a porcelain crucible; in this way the oxidation of the phosphorus is easily and perfectly accomplished. All the phosphorus estimations necessary in these researches have been performed in this manner.

Experiments in the Methyl Series.

Monomethylphosphinic Acid.—In order to obtain the product of oxidation of methylphosphine in appropriate quantity, a slow stream of the gas was directed into fuming nitric acid; it would have been unnecessary in this case to employ the phosphine gas in a state of purity. It was sufficient to make use of the methylphosphine as it is delivered from the crude product of the action of methyl-iodide on phosphorus iodide and zinc oxide by treatment with water. This gas always contains small quantities of phosphuretted hydrogen, which ignite on contact with the fuming acid and easily give rise to small explosions. As the methylphosphine becomes purer these become more seldom, and at last quite cease. Invariably, however, in consequence of these detonations, more or less phosphoric acid is formed amongst the products of oxidation.

To get rid of the nitric acid, the solution is several times evaporated to dryness on a water-bath, the residue dissolved in water, and the liquid boiled with lead oxide for the purpose of separating the phosphoric acid; a lead-salt is thus formed which is insoluble in water, but dissolves in acetic acid, leaving an appreciable residue of lead phosphate. This solution is freed from lead by means of sulphuretted hydrogen, and from acetic acid by repeatedly evaporating, when the new body remains as an oily liquid, which, on cooling, solidifies into a crystalline mass resembling spermaceti. The crystals thus produced, which could not be obtained in distinct forms, are hygroscopic, but not deliquescent. They readily dissolve in water, the solution restoring litmus red to blue, and possessing, moreover, an agreeable sour taste. They are also soluble in alcohol, less so in ether; the alcoholic solution, however, is not precipitated by ether. The stability of this body is quite remarkable; that it is not altered by fuming nitric acid is evident from the manner of its preparation; but even by repeated evaporation with *aqua regia* not the slightest change is produced.

The new compound melts at 105° C.; it is volatilised, at least for the greatest part, without decomposition; when strongly heated it evolves an inflammable gas, a small residue of phosphoric acid mixed with more or less carbon remaining behind.

Analysis showed that methylphosphine, by treatment with nitric acid, fixes three atoms of oxygen, the com-

* A paper read before the Royal Society.
† *D. Chem. Ges. Ber.*, 1870, p. 697.

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position of the new body being represented by the formula $CH_5PO_3=(CH_3)H_2PO_3$.

The new substance is a well-marked acid; I will designate it by the name placed at the head of the paragraph, *i.e.*, *monomethylphosphinic acid*, or, more briefly, *methylphosphinic acid*. It forms two series of salts, the construction of which is represented by the formulæ—

$$(CH_3)HMPO_3 \text{ and } (CH_3)M_2PO_3.$$

The primary (acid) salts are produced by the reaction of the metallic carbonates, or by incomplete saturation with the free bases. For the preparation of the secondary (neutral) salts, the acid must be completely saturated by the free bases. They can, however, also be obtained by means of the carbonates, if the latter, as is the case with the alkaline carbonates, are capable of fixing the carbonic acid which is liberated.

The primary methylphosphinates have an acid, the secondary salts an alkaline, reaction; these latter are soluble, and only little inclined to crystallise. The ammonium salts lose ammonia by evaporation, leaving the acid behind. Amongst the metallic salts, especially the primary ones, many are insoluble, or soluble only with difficulty.

Silver MethylPhosphinate.—If the acid be saturated with silver oxide, and the solution evaporated to the consistence of a syrup, the primary salt separates from the solution in beautiful white needles, which, however, in contact with water, and even with alcohol, are readily converted into the secondary salt with separation of the free acid.

The salts obtained by means of silver oxide, and purified by washing with water, gave numbers which showed that it consisted of a nearly pure secondary compound. In order to obtain this salt quite pure, the solution of the acid was accurately neutralised by ammonia and precipitated by silver nitrate. It is a white amorphous precipitate, nearly insoluble in water, having the composition $CH_3Ag_2PO_3$.

Lead Methylphosphinate.—If an aqueous solution of methylphosphinic acid be boiled with an insufficient quantity of lead oxide, the primary and secondary salts are formed at the same time, the latter as a white amorphous heavy powder which collects at the bottom of the hot liquid, the former crystallising from the liquid as it cools in beautiful, long, lustrous, white needles. On washing with water, the salt is decomposed like the silver compound, gradually forming the secondary salt and free acid. Indeed, analysis of the washed crystals gave numbers lying between those required for the primary and secondary salts. The secondary salt may be obtained, however, in a state of purity if the barium salt presently to be described be decomposed by lead acetate. It is a precipitate almost insoluble in water, but soluble in acetic acid. Its composition is $(CH_3)PbPO_3$, or perhaps more correctly $(CH_3)_2PbP_2O_6$.

Barium Methylphosphinate.—This is obtained by boiling the acid with barium carbonate, evaporating the solution to the consistence of a syrup, and precipitating by alcohol. It is a white powder, consisting of microscopic needles easily soluble in water. The aqueous solution, even on slow evaporation, yields no crystals, but dries to a gummy mass. Analysis showed the salt to be the primary compound $C_2H_6BaP_2O_6 = (CH_3)_2H_2BaP_2O_6$.

Methylphosphinic acid has the same composition as methylphosphorous acid, but it is only necessary to compare the above statements with what is known respecting the latter compound in order to see that they constitute two absolutely different bodies. Methylphosphorous acid is an uncrystallisable ephemeral compound, decomposing even at a gentle heat into phosphorous acid and methyl alcohol, and cannot possibly be mistaken for the extremely stable derivative of methylphosphine, which may even be distilled without undergoing any decomposition.

Dimethylphosphinic Acid.—By this name I designate an acid which is produced by the action of nitric acid on *the secondary methyl base.* In preparing this body it is convenient to start from the chlorhydrate of dimethylphosphine. A solution of this salt is readily obtained when the crude product of the action of phosphonium iodide on methyliodide after the expulsion of methylphosphine by water is distilled with alkali, and the dimethylphosphine thus disengaged is passed into hydrochloric acid. If this solution be mixed with fuming nitric acid, a powerful reaction ensues, heating the liquid to ebullition, and fumes of nitrous acid are copiously evolved. In order to free the strongly acid solution from nitric acid, it is repeatedly evaporated with hydrochloric acid, and then heated for some time on the water-bath to expel as far as possible also this latter body. To get rid of the last traces of hydrochloric acid, the liquid is saturated with silver oxide and the solution filtered from the silver chloride, precipitated by sulphuretted hydrogen. The solution again evaporated on the water-bath gradually solidifies to a white paraffin-like mass of crystals, which, on contact with the air, are apt to become slightly brown. They are very soluble in water, alcohol, and ether; these solutions have a decidedly acid reaction. The crystals melt at 76°; at a higher temperature they are volatilised without decomposition; indeed, the distilled product shows the same melting-point as the undistilled acid. Dimethylphosphinic acid is less soluble for analysis than the mono compound. It appeared sufficient to fix its composition by the examination of the silver-salt. This analysis proved that the acid is represented by the formula $C_2H_7PO_2 = (CH_3)_2HPO_2$. It is thus seen that dimethylphosphine, when treated with nitric acid, fixes not three atoms of oxygen, like the monomethylated base, but only two. Dimethylphosphinic acid forms only one series of salts having for the general formula $C_2H_6MPO_2 = (CH_3)_2MPO_2$.

Silver Dimethylphosphinate.—This salt is obtained by saturating the crude acid still retaining hydrochloric acid with silver oxide, evaporating the filtered solution, and precipitating the concentrated liquid with absolute alcohol. The salt presents itself in the form of fine felty white needles extremely soluble in water, but very slightly so in ether and absolute alcohol. Its composition is represented by the formula $C_2H_6AgPO_2 = (CH_3)_2AgPO_2$.

Barium Dimethylphosphinate.—By boiling the solution of the pure acid with an excess of precipitated barium carbonate, a neutral liquid is obtained, which, when evaporated on the water-bath, dries up to a transparent varnish. On contact with a hard body this clear varnish becomes opaque, and shows inclination to crystallise. It is soluble also in alcohol.

Lead Dimethylphosphinate.—The preparation is conducted in the same manner as that of the barium salt, only that oxide instead of carbonate is employed. In its properties it resembles the barium salt; the varnish dissolves in a small quantity of water; the solution becomes turbid, however, by the addition of a larger quantity. Several lead determinations showed excess of lead above that contained in the normal dimethylphosphinate, which cannot surprise when considering the tendency of lead to form basic salts and the absence of all properties warranting the purity of the compound.

It is of some interest to compare the behaviour of phosphuretted hydrogen under the influence of powerful oxidising agents with that of its several methylated substitution-products. Phosphuretted hydrogen, on treatment with concentrated nitric acid, fixes four atoms of oxygen, becoming converted into TRIBASIC orthophosphoric acid; methylphosphine similarly treated combines with only three atoms of oxygen, forming DIBASIC methylphosphinic acid, under the same conditions. Dimethylphosphine appropriates not more than two atoms, giving rise to *monobasic* dimethylphosphinic acid. Lastly, trimethylphosphine fixes but one atom of oxygen, the products of the reaction being trimethylphosphide oxide, observed some years ago by Cahours and myself; this body is *no longer capable of forming saline compounds.* We thus arrive at the following series:—

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$$H_3P+O_4 = H_3PO_4.$$
$$(CH_3)H_2P+O_3 = (CH_3)H_2PO_3.$$
$$(CH_3)_2HP+O_2 = (CH_3)_2HPO_2.$$
$$(CH_3)_3\ P+O = (CH_3)_3\ PO.$$

On examining this series it is observed at once that all the bodies here described are derived from phosphoric acid. The acids generalised from the methylated phosphines being phosphoric acid, the hydroxylic groups of which are successively replaced by methyl.

Orthophosphoric acid	HO HO HO	PO.
Methylphosphinic acid ..	CH_3 HO HO	PO.
Dimethylphosphinic acid ..	CH_3 CH_3 HO	PO.
Trimethylphosphine oxide ..	CH_3 CH_3 CH_3	PO.

This symmetrically constituted series does not stand alone. Indeed, orthoarsenic acid forms the starting-point of a perfectly analogous group of compounds, which are obtained, however, by processes different from those which yield the phosphorous bodies. The substances corresponding to methylphosphinic acid is arsenomonomethylic acid, discovered by M. Baeyer;† that analogous to dimethylphosphinic acid, the well-known kakodylic acid of M. Bunsen; finally, trimethylarsine oxide has been obtained by M. Cahours when submitting trimethylarsine to the action of oxidising agents.

Orthoarsenic acid	HO HO HO	AsO.
Arsenmonomethylic acid .. (Methylarsenic acid)	CH_3 HO HO	AsO.
Kakodylic acid .. .. .. (Dimethylarsenic acid ..	CH_3 CH_3 HO	AsO.
Trimethylarsine oxide ..	CH_3 CH_3 CH_3	AsO.

The formation of methyl- and dimethylphosphinic acids is thus seen to illustrate again the unmistakeable analogy of the two elements, phosphorus and arsenic, already traced in so many directions. I hope that the continuation of these researches will still further elucidate this similarity. There can be no doubt that the several members of the kakodyl series from which arsenomonomethylic and kakodylic acids have been produced will soon be represented amongst the derivatives of phosphorus. The discovery, too, of the primary and secondary arsines, the oxidation of which, as is obvious from the results described in this note, must yield the same acids, will probably not have long to be waited for.

(To be continued).

ON THE LAST NEW METAL, INDIUM.*

[By WILLIAM ODLING, M.B., F.R.S.
Fullerian Professor of Chemistry, R.I.

The word "element" is used by chemists in a peculiar and very limited sense. In calling certain bodies elements, there is no intention on the part of chemists to assert the undecomposable nature or essence of the bodies so called. There is not even an intention on their part to assert that these bodies may not suffer decomposition in certain of the processes to which they are occasionally subjected; but only to assert that they have not hitherto been proved to suffer decomposition; or, in other words, to assert that their observed behaviour under all the different modes of treatment to which they have been exposed, is consistent with the hypothesis of their not having undergone decomposition.

The entire matter of the earth then, so far as chemists are yet acquainted with it, is composed of some sixty-three different sorts of matter that are spoken of as elementary; not because they are conceived to be in their essence primitive or elementary, but because, neither in the course of nature nor in the processes of art, have they been observed to suffer decomposition. No one of them has ever been observed to suffer the loss of any substance different from the substance of its entirety, so as to leave a residuary substance different from the substance of its entirety. Thus chemists are incapable of taking away from iron, for example, a something that is not iron; or of taking away from it anything whatever, so as to leave a residue that is not iron; whereas they are capable of taking away from iron pyrites a something which is not iron pyrites but is sulphur, so as to leave a residue which is not iron pyrites but is metallic iron.

The notion of all other material bodies being constituted of, and decomposable into, a limited number of elementary bodies, which could not themselves be proved to suffer decomposition or mutual transformation under any circumstances whatever, but could, on the contrary, be traced respectively through entire series of combinations, and be extracted at will from each member of the series, is a notion which, undergoing in course of time a gradual development, was first put forward in a definite form by Lavoisier; until whose time, some residue of the great alchemical doctrine of the essential transmutability of all things—that the substance of all things was the same, while the form above was different—still prevailed. To Lavoisier is due the enunciation of the principle,—departed from, however, in a few instances by himself,—that all bodies which cannot be proved to be compounded, are in practical effect, if not in absolute fact, elementary, and are to be dealt with accordingly.

Of the many definite substances known to chemists before the discovery of hydrogen gas, the following were afterwards recognised by Lavoisier and his colleagues as elementary. First, the seven metals known to the ancients, namely, gold, silver, mercury, copper, iron, tin, and lead, distinguished respectively by the signs of the sun, moon, and planets; and each conceived to have some mystic connection with the particular orb or planet of which it bore the sign, and not unfrequently the name. Then three metals which became known at the latter end of the fifteenth or beginning of the sixteenth century, namely, antimony, discovered by Basil Valentine in 1490; bismuth, mentioned by Agricola, 1530; and zinc, mentioned by Paracelsus, ob. 1541. An elementary character was also assigned to the non-metals carbon and sulphur, which had been known from the earliest times; to phosphorus, discovered by Brandt, of Hamburg, in 1669; and to boracic acid, now known to be a hydrated oxide of boron, first discovered by Homberg in 1702, and still occasionally spoken of as Homberg's sedative salt. The list was further swelled by four metals which, in Lavoisier's time, had been but recently discovered, namely, cobalt and arsenic, identified simultaneously in 1733 by George Brandt, of Stockholm; platinum, discovered in 1741 by Woods, assay-master at Jamaica; and nickel, discovered in 1751 by Cronstedt.

The only other bodies known before 1766, and afterwards included in the class of elements, namely, the alkalies and earths, had during the quarter of a century immediately preceding been made the subjects of especial study. The differentiation of potash from soda, both previously known by the common name of alkali, was indicated by Duhamel in 1736, and more completely established by Marggraf in 1758. The differentiation from one another of lime or calcareous earth, silex or vitrefiable

* Read before the Royal Institution of Great Britain.

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earth, alumina or argillaceous earth, and magnesia or bitter earth, was accomplished by the labour of many chemists, more particularly Marggraf, Bergmann, and Scheele; prior to whose researches silex, alumina, and magnesia, together with their different combinations and commixtures with each other and with lime, were held to be but impure varieties of lime. The nature of the difference between the caustic alkalies and earths and their respective carbonates was made known by Black in 1756; while the real constitution of the alkalies and earths, as metallic oxides, though suspected by Lavoisier, was not established until the beginning of the present century, by Davy and his contemporaries and followers.

TABLE I.--ELEMENTS, &c., IN ORDER OF DISCOVERY.

—	Gold	☉
—	Silver	☽
—	Mercury ..	☿
—	Copper ..	♀
—	Iron	♂
—	Tin	♃
—	Lead	♄
1490	Antimony ..	B. Valentine.
1530	Bismuth ..	Agricola?
1541	Zinc	Paracelsus?
—	Carbon ..	
—	Sulphur ..	
1669	Phosphorus .	Brandt.
1702	Borax -on ..	Homberg.
1733	Arsenic ..	G. Brandt.
1733	Cobalt	G. Brandt.
1741	Platinum ..	Woods.
1751	Nickel	Cronstedt.
1736 to 1758	Soda -ium ..	Duhamel.
	Potash	Marggraf.
	Lime	Marggraf.
	Silex	Marggraf.
	Alumina ..	Bergmann & Scheele.
	Magnesia ..	Bergmann & Scheele.
1766	Hydrogen ..	Cavendish.
1771	Fluor -ine ..	Scheele.
1772	Nitrogen ..	Rutherford.
1774	Chlorine ..	Scheele.
1774	Oxygen ..	Priestley.
1774	Manganese .	Gahn.
1774	Baryta -ium .	Scheele.
1778	Molybdenum	Scheele.
1781	Tungsten ..	Delhuart.
1782	Tellurium ..	Müller.
1789	Uranium ..	Klaproth.
1789	Zirconia -ium	Klaproth.
1791	Titanium ..	Gregor.
1793	Strontia -ium	Hope.
1794	Yttria -ium..	Gadolin.
1797	Chromium ..	Vauquelin.
1798	Glucina -um .	Vauquelin.
1802	Tantalum ..	Hatchett.
1803	Cerium ..	Klaproth.
1803	Palladium ..	Wollaston.
1803	Rhodium ..	Wollaston.
1803	Iridium ..	Descotils & Smithson Tennant.
1803	Osmium ..	Descotils & Smithson Tennant.
1811	Iodine	Courtois.
1817	Lithium ..	Arfwedson.
1817	Selenium ..	Berzelius.
1818	Cadmium ..	Stromeyer.
1826	Bromine ..	Balard.
1828	Thorinum ..	Berzelius.
1830	Vanadium ..	Sefstrom.
1839	Lanthanum .	Mosander.
1841	Didymium ..	Mosander.
1843	Erbium ..	Mosander.
1844	Ruthenium..	Claus.
1846	*Niobium* ..	H. Rose.
1859	Cæsium ..	Bunsen.
1859	Rubidium ..	Bunsen.
1861	Thallium ..	Crookes.
1863	Indium ..	Reich & Richter.

The successive recognition of the elementary gases quickly following Black's remarkable discovery of carbonic acid gas, began by the identification of hydrogen by Cavendish in 1766. This was succeeded by the discovery of nitrogen by Rutherford in 1772; of chlorine and fluoric acid, the latter now held to be a fluoride of hydrogen, by Scheele in 1774; and of oxygen by Priestley in the same year.

Thus prior to the discovery of the first of the elementary gases, twenty-three kinds of solid matter, and one liquid body, mercury, were known, which afterwards became recognised as elements. Between then and the present time, thirty-three kinds of solid matter, and one liquid body, bromine, have been added to the list—the discovery of the earliest of them occurring almost simultaneously with, or even just preceding, that of the last discovered of the elementary gases.

Among the number of bodies discovered prior to 1803, when Davy effected the decomposition of the alkalies, several, at first thought to be elementary, are now known to be compounds of oxygen with other bodies still regarded as elements; and conversely, two bodies, namely, chlorine and fluorine, at one time thought to be oxides, have since become regarded as elementary; but in none of these cases did the discovery of what is now considered to be the real constitution of the bodies add or subtract an element to or from the list.

From the period of the modern or Lavoisierian conception of elements and compounds down to the beginning of the nineteenth century, the recognition of new elements occurred with much frequency, at short but varied intervals. After then, the discoveries became somewhat less frequent; but even within the last fifty years, no fewer than twelve new elements have been added to the list, being at the rate of one new element every four years. Throughout, the periods of discovery have been somewhat irregular in their occurrence. Thus in the years 1802 and 1803, six new elements were discovered, namely, tantalum, cerium, palladium, rhodium, iridium, and osmium; within the succeeding fourteen years only one new element, but that a very important one, namely, iodine; and in the fifteenth and sixteenth years, three new elements, namely, lithium, selenium, and cadmium. The longest barren interval, one of thirteen years' duration, took place between the discovery of niobium, by Rose, in 1846, and that of cæsium and rubidium, by Bunsen, in 1859. The last discovered of the elements, namely indium, being fully seven years old, and there being no reason to consider our present list as anything like complete, or to apprehend any cessation of additions thereto, it is now quite time for some other new element to be made known. For we may reasonably anticipate the discovery of new elements to take place at irregular intervals, possibly for centuries to come, and our list of the elements to be increased at least as much in the future as in the past.

The fresh discovery, however, of any abundant elementary constituent of the earth's crust would seem scarcely now to be expected, seeing that of the thirty-two elements which have become known since the year 1774—the year of the discovery of chlorine and oxygen and manganese and baryta—the great majority belong to the class of chemical curiosities; while even the four or five most abundant of the since discovered elements are found to enjoy but a sparing although wide distribution in nature, as is the case, for example, with bromine and iodine; or else to be concentrated but in a few specially localised minerals, as is the case, for example, with strontium and chromium, and tungsten. Of course it is difficult to appraise the relative abundance in nature of different elements; more especially from the circumstance of those

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which are put to commercial uses being everywhere sought for, and those not put to commercial uses being habitually neglected—save indeed by the man of science, to whom the peculiar properties of some of the less familiarly known elements, as palladium, osmium, erbium, didymium, uranium, and thallium, render them objects of the highest interest.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, May 16th, 1872.

DR. DEBUS, F.R.S., Vice-President, in the Chair.

AFTER the minutes of the previous meeting had been read, Messrs. J. Robins and A. J. Dickinson were formally admitted members of the Society.

The donations to the Society having been announced, the following names were read for the first time:—Messrs. John Emilius Shadwell, M.A., Walter Weldon, Walter Stewart, jun., John Ferguson, M.A., Charles Armbruster, George J. Snelus, and R. Wormell, M.A., B.Sc.

For the third time—Messrs. C. H. W. Biggs, John Grove Johnson, Joseph Arderne Ormered, B.A., and Ernest Henry Jacob, B.A., who were then ballotted for and duly elected.

Mr. H. T. BROWN then read a paper "*On the Influence of Pressure upon Fermentation, Part I.*" In this investigation the author found that during the alcoholic fermentation of grape juice or malt wort, besides carbonic anhydride, that nitrogen, hydrogen, a hydrocarbon of the paraffin group, and sometimes nitric oxide, are evolved; moreover, the proportion of the gases unabsorbed by potassium hydrate is largely increased when the operation is carried on under diminished pressure. At the ordinary pressure, by far the larger proportion of these gases is nitrogen (70 to 90 per cent), but under diminished pressure, 400 to 450 m.m., the hydrogen preponderates (60 to 90 per cent). Nitrogen, however, does not occur when the solutions contain no albumenoids, even if ammonium salts are present in considerable quantity. The increase of the proportion of hydrogen, resulting from diminution of the pressure, is accompanied by formation of a comparatively large amount of acetic acid and aldehyde, so that it would seem that water is decomposed during the alcoholic fermentation, and that this result is facilitated by the diminution of the pressure. The presence of nitric oxide in the evolved gases was found to be due to the reduction of nitrates originally present in the solutions.

Dr. DEBUS said he had listened with great interest to the author's excellent paper on fermentation: it was a subject which had attracted the attention of chemists from a very early period.

Dr. WILLIAMSON expressed the cordial pleasure he had experienced in hearing Mr. Brown's account of the excellent and accurate experiments he had made. From the exceedingly novel and remarkable results obtained under diminished pressure, he was sure that those who, like himself, took an interest in the subject of fermentation, would look forward with pleasure to a further extension of these experiments.

Mr. VERNON HARCOURT said there was one point particularly worthy of notice in these observations—namely, the alteration produced by the change in pressure Operating, as we ordinarily do, at the atmospheric pressure, which varies comparatively little, we do not take sufficient account of the altered circumstances produced by change of pressure. An instance of this had come under his notice in endeavouring to prepare pure ammonium nitrite: at the ordinary pressure, its aqueous solution is quite stable, but on attempting to evaporate it *in vacuo* over sulphuric acid, he found the diminished pressure produced an effervescence, decomposition ensued, and nitrogen was evolved.

Mr. BROWN then read a preliminary notice "*On the Electrolysis of Sugar Solutions.*" A solution of glucose, when subjected to the action of the electric current, gives off, besides hydrogen and oxygen, a considerable quantity of carbonic acid and some carbonic oxide; the solution was then found to contain aldehyde, much acetic acid, and a little formic acid. Although not yet experimentally proved, the author believed that alcohol was formed during the electrolysis.

Dr. DEBUS, in thanking the author in the name of the Society, remarked that it would be very interesting if it should one day be found that alcohol could be produced from sugar without fermentation.

A paper "*On the Determination of the Solubility and Specific Gravity of Certain Salts of Sodium and Potassium,*" by D. PAGE, M.B., and A. D. KEIGHTLEY, was then read for the authors by Mr. Hartley. The authors have carefully determined the solubility and density of saturated solutions of sodium and potassium nitrates and chlorides at a temperature of 15·6° C. The specific gravity of each of these salts at the same temperature was also accurately ascertained; and lastly, the specific gravity and degree of solubility of these salts in presence of each other was determined.

Mr. ATKINSON then read "*An Examination of a Recent Attack upon the Atomic Theory,*" having reference to a paper by Dr. Wright "On the Relations between the Atomic Hypothesis and the Condensed Symbolic Expressions of Chemical Facts and Changes known as Dissected (Structural) Formulæ," recently read before the Society, and published in the April number of the *Phil. Mag.* The speaker said that Dr. Wright, notwithstanding his having asserted that the atomic theory is unnecessary, invariably uses it, arguing that we must either accept the atomic theory in order to revise the approximate results obtained in any given analyses, or adopt the actual number obtained, instancing Roscoe's analyses and determination of the vapour density of tungsten oxychloride and other tungsten compounds. Dr. Wright refers to the law of multiple proportions as one of the facts of chemistry; but experiment does not lead to numbers which are multiples of his combining numbers—that is, the law of multiple proportions is not an experimental fact. Thus, the vapour density of ferric chloride would lead to the atomic weight 112 for iron and that of aluminium chloride to 55 for aluminium. Dr. Wright's analysis of hydrobromate of bromocodide would lead him to the formula $C_{18}\frac{1}{2}H_{22}\frac{1}{2}Br_1\frac{1}{2}NO_2$, instead of $C_{18}H_{21}Br_2NO_2$, the one he had adopted; instead, however, of accepting the numbers obtained by analysis, he rejects them, and takes the nearest numbers which yield a formula containing only integral multiples of atomic weights. He also said that Dr. Wright had not attempted to explain the cause of isomerism, which can be readily done by the notion of the existence of atoms associated in different relative positions.

Dr. WRIGHT said it was somewhat difficult to reply to a large number of objections which one had only just heard for the first time. He was afraid Mr. Atkinson had failed to understand the object of his paper, which was to distinguish between the employment of certain symbols to express certain facts, and the adoption of the atomic hypothesis to explain these facts. One of the charges was that of denying the atomic theory, and yet of employing that theory, the instance adduced being, that the approximate results obtained by his analysis of hydrobromate of bromocodide would lead to the formula $C_{18}\frac{1}{2}H_{22}\frac{1}{2}Br_1\frac{1}{2}NO_2$. He need only say that, taking into account the errors of experiment, such as the presence of water, &c., the nearest whole numbers which represent his results lead to the formula $C_{18}H_{21}Br_2NO_2$, and that, in assigning this as the formula, he did so quite independently of the atomic theory. With regard to his observa-

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tions that the determination of the vapour density of ferric chloride and aluminium chloride would lead to he numbers Fe=112 and Al=55, the author seemed to have forgotten that the speaker had especially stated that compounds that dissociate, or are believed to do so, must be excluded in the determination of the combining number of the element. It is quite possible to express symbolically the difference between isomeric compounds without reference to any theory whatever; the two isomeric propylic alcohols, for instance, when treated with reagents, give rise to different products, and these facts can be recalled by the employment of symbols apart from all theoretical considerations. The speaker could scarcely see what great advantage was gained by the discussion of such a purely theoretical question as the constitution of matter, the important point being to express symbolically the facts with which we are acquainted. At present, sufficient distinction was not made between Dalton's proposal to represent the results of his quantitative analyses by symbols, and the theory founded on these results, namely, that matter is built up of small particles or atoms, and these again are united to form molecules. The latter was a subject which admitted of much discussion. The use of symbols to represent facts quite apart from any theory, gave us a power similar to that which the symbols in algebra gives to the mathematician.

Mr. J. NEWLANDS observed that there was one part of Dalton's atomic theory which did not appear to be absolutely necessary to explain existing facts. Taking the simplest possible case, that of sodic chloride, and granting that this substance consists of molecules, each containing one atom of sodium united with one atom of chlorine, it seems hardly necessary to assume that all the individual atoms of sodium on the one hand, or of chlorine on the other, have precisely the same weight. It would seem to be sufficient to consider the numbers 23 and 35·5 as expressing not the relative individual weight, but the relative average weight of the atoms of sodium and chlorine.

Dr. DIVERS said there was one point he would like to refer to, and that was whether, in sodium-chloride, for instance, the sodium and the chlorine existed as such. On bringing together chlorine and sodium, the two united, with production of intense heat, and forming a compound as different from either sodium or chlorine as these were from one another. True we could obtain these elements from the compound, but we could not say they exist in it as such. We know nothing of the structure of complex substances, only that by certain reactions they yield certain products. It is quite possible, therefore, that although we get out the same elements from two isomeric bodies, these may differ in the amount of force they contain.

Dr. WILLIAMSON remarked that, although it was a question of very great difficulty to decide upon things so remote from our senses as these minute particles of which matter was built up, yet it was no more unreasonable to do so than with the enormous masses in the remote regions of our planetary system. He must say that those who considered it simply the part of science to record the results of observations, and not to endeavour to connect them with one another, know not what science was. A theory different from the atomic theory would be very valuable by reason of its giving us another point of view from which we might behold the facts with which we are acquainted. He would hail such a theory with delight.

Mr. ATKINSON said it would be unnecessary for him to reply, as most of the points raised had been refuted by subsequent speakers.

The CHAIRMAN was inclined to think that the representation of facts by symbols without connection with some theory, was very like a body without a soul; the human mind could never rest satisfied simply with the outside representation of things, but would look for the causes which connect them. From about 1808 to 1820, the dynamical theory advanced by Kant was generally employed in Germany, and it is remarkable that no great discoveries were made, and that no eminent chemists existed there during that period, whilst in England and in France, where the atomic theory was adopted, science advanced rapidly. When, however, Germany adopted the atomic theory, chemistry at once began to improve. These things spoke for themselves.

Mr. C. O'SULLIVAN then read a paper "*On the Transformation Products of Starch*," in which the author referred to the experiments of Musculus, Payen, and Schwarzer, which he repeated, but only obtained results partly agreeing with theirs. This induced him to undertake a series of experiments to ascertain what were really the products of the transformation of starch under the influence of malt extract and of acids. The paper contains a detailed account of the numerous and carefully conducted experiments made with this object; the most important point being that he obtained, as the end product of the action of malt extract on starch, a sugar, *maltose*, isomeric with lactose, which only reduces two-thirds of the cupric oxide which dextrose does. By the continued action of acids it is converted into dextrose.

Dr. DEBUS, after thanking the author, announced that the Faraday lecture would be given by Professor Canniszaro, of Palermo, "Sur les Limites et sur la Forme de l'Enseignement Theorique de la Chimie dans les Universités," at the Royal Institution, on Thursday, the 30th of May, at 8 o'clock.

NOTICES OF BOOKS.

Natural Philosophy for General Readers and Young Persons. Translated and edited from Ganot's "Cours Elémentaire de Physique." By E. ATKINSON, Ph.D., F.C.S., Professor of Experimental Science in the Staff College. London: Longmans and Co., 1872. 522 pp.

THIS work has its origin in an attempt to comply with a suggestion that Dr. Atkinson should prepare an abridged edition of his translation of Ganot's "Elements de Physique," which could be used for purposes of more elementary instruction than that work, and in which the use of mathematical formulæ would be dispensed with. But such an adaptation Dr. Atkinson found incompatible with the nature of the larger work, and he therefore turned his attention to the translation of another book, by the same author, the "Cours Elémentaire de Physique." But Dr. Atkinson does not perform merely the mechanical part of a translator; for he has made many additions to the work, experience having taught him that such additions and even alterations would be necessary before the work could be introduced to the middle and upper classes of boys' and of girls' schools in England. Our scholastic *régime*, though in some cases founded upon, differs in essential particulars from, that pursued in French schools. On the Continent, schools are much better furnished with elementary apparatus than with us, while in their attention to detail our neighbours keep the apparatus they possess in much better order than we. The work under notice treats of the general properties of matter, hydrostatics, the properties of gases, acoustics, heat, light, magnetism, and electricity. While the illustrations to many of our scientific school-books are, in the extreme, poor in design, those of our continental neighbours are generally attractive little sketches, much more likely to make an impression upon a youth's fancy. In this case Dr. Atkinson has done well to retain the original woodcuts. Take, for instance, the engraving representing the action and mode of connection of the electric telegraph. First, there is represented a battery and simple Morse instrument when the circuit is broken; then with the circuit completed, and the armature attracted. These illustrations are shown with a second wire; next follows a lucid description how one of these wires is rendered un-

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necessary by the formation of an earth connection; and finally, there are two woodcuts, in admirable detail, exhibiting the sending and the receiving-clerks at work. In this manner Dr. Atkinson vividly pictures the practical applications of science to the student's eye, a terse description completing the elucidation. There will be found, we are sure, no book more acceptable whether to the teacher or the student.

CORRESPONDENCE.

LECTURE ILLUSTRATIONS.—ACTION OF LENSES.

To the Editor of the Chemical News.

SIR,—In the last number (April) of the *Quarterly Journal of Science* I was interested with the ingenious plan suggested by Dr. Ferguson for the construction of a vertical lantern with very simple materials. I have tried his plan and find that it is very effective. I would suggest also another simplification (*i.e.*) to replace the photographic or other objective lens by a watch-glass filled with water. This will produce a lens which, if the other parts of the apparatus are well proportioned, will give a very excellent image. Following out this suggestion, I find that a very striking popular illustration of refraction and its relation to the formation of images by lenses may be thus arranged. Placing as an object in the field of the ordinary vertical lantern some strongly-marked pictures, such as a photograph of a statue, we arrange an empty watch-glass in the place of the objective. There will then appear in the screen only a nebulous mass of light showing no detail of the object. On now pouring water into the watch-glass a clearly-defined image will make its appearance as soon as the liquid comes to rest. Emptying the glass and re-filling it with alcohol or any other highly refracting liquid, such, for example, as a solution of the chloride of tin, the image will appear out of focus until the lens is brought nearer to the object, when a correspondingly enlarged image will be formed. This method might, in fact, be applied to the measurement of indices of refraction.

That so rude a lens as a watch-glass full of water will make a good image, comes from the fact that the rays which go to form any one point of the image are not transmitted by the objective as a whole (as is the case with an ordinary camera lens or a telescope), but pass through a small element of the lens only, and, hence, are affected by a minute spherical and chromatic error, and not by that due to the entire aperture of the lens.* As a consequence of this, such a shape as will best secure flatness of field without reference to spherical or chromatic correction gives the best general effect, and this condition is very well secured by a common plano-convex lens with its curved surface towards the object.

A similar result is arrived at in quite another way in that very remarkable combination the *Z*entmayer view lens,† which, while entirely without correction in the usual sense (being made of only one kind of glass) is yet so *correct* that it compares favourably with the best corrected lenses. It has a small diaphragm at its centre, and thus the rays that form any point of the image are limited to passage through a correspondingly small element of the lens. It thus acts like a group of minute lenses, each one of which produces a different part of the picture. This lens involves many other interesting points as causes of its remarkable efficiency, but I would only cite this one in illustration of the general principle noticed above.—I am, &c.,

HENRY MERTON.

Stevens's Institute of Technology,
Hoboken, New Jersey.

* *Journal of Franklin Institute*, 1867, vol. liv., p. 339.
† *Ibid.*, vol. lii., p. 63, and vol. lvi., p. 152.

DR. ANGUS SMITH'S RESEARCHES ON THE ATMOSPHERE.

To the Editor of the Chemical News.

SIR,—In reading Dr. Smith's admirable book on "Air and Rain," I was struck with the fact that the atmosphere is liable to pollution on much the same scale as drinking-water. In the air of "Innellan," for instance, Dr. Smith found "free" and "albumenoid" ammonia in the proportion of 52·3 grammes of "free" and 137·8 grammes of "albumenoid" in one million cubic metres of air. One kilogramme of the air of Innellan, therefore, contains 0·04 milligramme of free ammonia and 0·11 milligramme of albumenoid ammonia.

Translating Dr. Smith's table, which occurs on page 438 of his book, we have—

In one kilogramme of air :—

	Milligrammes.	
	Free Ammonia.	Albumenoid Ammonia.
Innellan	0·04	0·11
London	0·05	0·12
Glasgow	0·06	0·24
A bedroom	0·08	0·19
Inside and outside office at Manchester	0·10	0·20
Underground Railway, Metroplitan	0·06	0·29
A midden	0·26	0·31

This very interesting Table shows that pure air from the country and open parts of healthy towns is nearly, but not quite, as free from organic impurity as good drinking water, and that a kilogramme of air from the neighbourhood of a midden contains very nearly as much impurity as a kilogramme of water from a bad well.

Dr. Smith's determinations of the chlorides and sulphates in the air of different places admit likewise of convenient expression in the kilogramme scale.

In venturing to suggest that the new air analyses should be expressed on the kilogramme scale, I have in view the possibility of examinations of air becoming popular, as examinations of drinking-water have become. With this object in view, a simple method of registering results assumes some degree of importance, and I have accordingly put forward that which appears to me to be the simplest kind of notation.—I am, &c.,

J. ALFRED WANKLYN.

ATOMIC THEORY.

To the Editor of the Chemical News.

SIR,—I should feel much obliged if you could afford me space to make one or two observations on a paper entitled, "An Examination of a Recent Attack upon the Atomic Theory," which was read before the Chemical Society on the 16th inst., and of which a report will doubtless appear in the current number of your journal.

Mr. Atkinson, the author of the above-mentioned paper, made one or two remarkably strange assertions. After quoting the results obtained by Roscoe in the analyses of the tungsten chlorides he said—"From this example it will be seen that the law of multiple proportions cannot be termed an experimental fact;" and again some time afterwards, "It has been shown above that the law of multiple proportions is not an experimental fact." I was afraid that I had forgotten what the term "law" meant as employed when discussing questions in physics, so on reaching home, I turned up my "Whately's Logic," and there found that the term "law of nature"—I presume the law of multiple proportions is one—is used "to denote the statement of some general *fact*, the several instances of which exhibit a conformity to that statement;" or, in other words, a physical law is a

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generalisation of *facts*. Can you tell me, Mr. Editor, whether Whately is right or Mr. Atkinson?

From what the latter gentlemen said, it might be inferred that the *law* of multiple proportion is founded on the atomic *theory*. I always thought, in my ignorance, that the reverse was the case, and that theories should be founded on laws. It might be imagined that Kepler derived his well-known laws from Sir Isaac Newton's theory of gravitation, but unfortunately he had been dead a dozen years at the time the latter was born.—I am, &c.,

AN AGGRIEVED ATOM.

WASTE OF SULPHUR AND LOSS OF NATIONAL WEALTH.

To the Editor of the Chemical News.

SIR,—Whilst minerals of every description are rising in value, it will scarcely be credited, although such is the fact, that in several of the tin mines in Cornwall at the present time, a large source of what ought to produce wealth is allowed to be wasted.

Large quantities of sulphurous fumes are allowed to pass off daily in calcining the tin stuff instead of manufacturing it into sulphuric acid.

I know of an instance where three tons of sulphur are daily allowed to escape, which if manufactured into sulphuric acid, the present price of which is £3 10s. per ton, would yield a revenue of more than £12,000 a year.

Whilst Spain and Portugal and other parts of Europe are ransacked to find sulphur ores to supply the manufacturers of sulphuric acid, in Cornwall all these sources of wealth are allowed to be wasted.—I am, &c.

W. H. TAYLER, M.D.

Tudor House, Anerley, Surrey,
May 14, 1872.

RELATIONS BETWEEN THE ATOMIC WEIGHTS OF CANNIZZARO.

To the Editor of the Chemical News.

SIR,—As several papers have recently appeared both in this country and on the Continent, on the subject of "Relations between the Atomic Weights of Cannizzaro," may I be permitted to remind your readers that most of these relations were pointed out in a paper written by myself, and published in the CHEMICAL NEWS for July 30, 1864 (vol. x., p. 59). In a subsequent paper, published in the CHEMICAL NEWS for August 20, 1864 (vol. x., p. 95), I showed that the elements belonging to the same group stood to each other in a relation similar to that between the extremes of one or more octaves in music. In the CHEMICAL NEWS for August 18 and 25 1865 (vol. xii., pp. 83 and 94), I discussed the whole question; and on March 1, 1866, read a paper on the subject before the Chemical Society, when I showed that it was only with the atomic weights of Cannizzaro that such extremely simple relationship could be observed, thereby constituting an independent argument in favour of this system of atomic weights.

As a former not unfrequent writer in your journal, may I request the insertion of the above few lines to vindicate my priority in this matter.—I am, &c.,

JOHN A. R. NEWLANDS, F.C.S.

9, Mincing Lane, E.C., May 21, 1872.

NOTES AND QUERIES.

Free Acid in Superphosphate.—Will some of your able readers inform me if it is possible to find free sulphuric acid in superphosphate, containing at the same time precipitated phosphate and neutral phosphate of lime?—IGNORAMUS.

Corrosion of Steam Chests and Cylinders.—Will some *reader* kindly supply information respecting corrosion of steam chests and cylinders, especially in connection with different kinds of grease employed?—K.C.

Chemical Works.—Will any of your readers kindly furnish me with some information respecting the titles, prices, and places for purchasing the chemical works of Messrs. Kunkel, Neri, and Fontaineu, more especially the latter?—EUDOXA.

MEETINGS FOR THE WEEK.

MONDAY, May 27th.—Royal Geographical 1 (Anniversary).
— London Institution, 4. Prof. Bentley, F.L.S., "On Elementary Botany.
TUESDAY, 28th.—Civil Engineers, 8.
— Royal Institution, 3. E. B. Tylor, F.R.S., "On the Development of Belief and Custom amongst the Lower Races of Mankind."
WEDNESDAY, 29th.—Society of Arts, 8.
THURSDAY, 30th.—Royal, 8.30.
— Royal Institution, 3. Prof. Tyndall, LL.D., F.R.S., "On Heat and Light."
— London Institution, 7.30. Mr. W. N. Hartley, F.C.S., "On Experimental Evidence against the Spontaneous Generation of Living Things."
FRIDAY, 31st.—Royal Institution, 9. Mr. E. J. Poynter, "On Old and New Art."
SATURDAY, June 1st.—Royal Institution, 3. Prof. Roscoe, F.R.S., "On the Chemical Action of Light."

TO CORRESPONDENTS.

W. F. White.—You will find the information in Watts's "Index of Spectra." Our Publisher will forward a copy on receipt of 7s. 10d.

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THE CHEMICAL NEWS.

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ON THE LAST NEW METAL, INDIUM.*

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(Continued from page 249).

A VERY notable point with regard to the last-discovered four elements, namely, rubidium, cæsium, thallium, and indium, is their successive discovery within a few years of each other, by one and the same process, namely, that of spectrum analysis. This process, invented and made available as a means of chemical research by Bunsen and Kirchhoff in 1859, consists simply in allowing the light given off by different ignited gases and vapours, limited by means of a fine slit, to pass through a prism or succession of prisms; and in observing the so-produced, brightly-coloured, widely-extended image of the slit. It has been known from the days of Newton, that by the passage of heterogeneous light through a prismatic highly dispersive medium, its differently refrangible constituents become widely separated from each other, so as to furnish an elongated coloured spectrum. But whereas the spectra of incandescent solid and liquid bodies are continuous, and not distinctive of the particular luminous bodies yielding them, the spectra of incandescent gaseous or vaporised bodies are found to be discontinuous, and to consist of one or more bright lines of different colour, thickness, and position, according to the nature of the particular incandescent gases or vapours from which the light through the slit is proceeding. In this way it is found that the spectra of the different chemical elements, alike when free and in combination, are perfectly definite, and characteristic of the particular elements vaporised and made incandescent.* And in many cases, the spectra or portions of the spectra of particular elements, even when present in the most minute proportion, are so extremely well marked and distinctive, that the presence or absence of these elements is determinable with the greatest ease and certainty, by a mere inspection of the emission spectra yielded by the incandescent gases or vapours under examination. Moreover, gases and vapours are further capable of affecting heterogeneous light which is passed through them; and of thus yielding absorption spectra, in which the characteristic lines of the above-described emission spectra are reversed, so as to appear, unaltered in position, as black lines or intervals in an otherwise continuous band of colour.

Now the salts of the alkali-metals, lithium, sodium, and potassium, and certain of the salts of the alkaline-earth metals, calcium, strontium, and barium, being very readily volatile, upon heating these salts, in the non-luminous flame of a Bunsen gas-burner for example, they undergo vaporisation, and their vapours become incandescent and capable of yielding the characteristic emission spectra of the particular metals. In examining in this way the alkali-salt residue of a mineral water from Durkheim, Bunsen observed in the spectrum before him certain coloured lines not belonging to any one of the then known alkalies, potash, soda, or lithia; and yet necessarily belonging to some substance having the general characters of an alkali, since all other bodies than alkalies had been previously removed from the residue under examination. In full reliance upon the certainty of this conclusion, Bunsen evaporated some forty tons of the water in question; and from the alkali-salt residue, succeeded in extracting and separating salts of two new alkali-metals, each characterised by a well-marked pair of lines in the blue or indigo, and one of them having in addition a pair of well-marked lines of extremely small refrangibility in the red of the spectrum. From its yielding those red lines, the one metal was named rubidium; the other, of which the bright blue lines were especially characteristic, being called cæsium.

The very general distribution in nature of these two elements was speedily established, and salts of each of them were, with much labour, eventually prepared in a state of purity and in reasonable quantity. From certain of their respective salts the metals themselves were obtained by the usual processes, and together with their salts, were submitted to detailed chemical examination. And no sooner was this examination made, than the position of the newly-discovered elements, as members of the alkali-metal family, at once became apparent. Rubidium and cæsium were found in all their properties to present the most striking analogy to potassium, and evidently to stand to this metal in the same relation that strontium and barium respectively stand to calcium; while they differed from sodium much as strontium and barium respectively differ from magnesium. This relationship in obvious properties was further borne out by the relationship of their atomic weights, thus:—

Mg 24		Na 23	F 19		O 16
Ca 40	K 39		Cl 35·5	S 32	
Sr 87	Rb 85		Br 80	Se 79	
Ba 137	Cs 133		I 127	Te 129	

It is observable that the sequence of atomic weight in the thus completed alkali-metal family, is strictly parallel to the previously well-known sequences in the alkali-earth metal family, and in the halogen and oxygen families respectively. Moreover, just as the basylity of the alkaline-earth metals increases in the order of their several atomic weights—calcium being less basylous than strontium, and far less basylous than barium—so also is the basylity of potassium inferior to that of rubidium, and the basylity of rubidium inferior to that of cæsium, which is indeed the most powerfully basylous, or oxidisable, or electro-positive element known.

Since 1860, both rubidium and cæsium have been recognised as minute constituents of a considerable number of minerals and mineral waters, rubidium having been met with for the most part in a larger proportion by weight than cæsium. Unlike potash, originally known as vegetable alkali, cæsium has not been recognised in the vegetable kingdom; but rubidium has been found as a very common minute constituent of vegetable ashes, as those of beet-root, oak-wood, tobacco, grapes, coffee, tea, &c., On the other hand, cæsium, free from rubidium, has been found in a tolerably well-known, though rare, mineral from the Island of Elba, to the extent of 32 per cent by weight of the mineral. The history of this mineral is curious: from the circumstance of its always occurring in association with another mineral, a variety of petalite, the two were called Castor and Pollux. Castor was found to be substantially a silicate of alumina and lithia; pollux a silicate of alumina, and, as it was thought, of potash. The constituents of pollux, namely, silica, alumina, and potash, with small proportions of ferric oxide, lime, soda, and water, were duly estimated; but the quantities of these constituents, found in 100 parts of the mineral, instead of amounting to 100 parts or thereabouts, amounted only to 88 parts, there being somehow a loss of 12 per cent in the analysis. After Bunsen's discovery of the new alkali-metals, pollux was analysed afresh by Pisani, who soon perceived that what had formerly been taken for potash, and estimated as potash, was not potash at all, but cæsia. Then calculating out his own analysis with cæsia instead of potash, substituting the one for the other in the proportion of 133+8, or 141 parts of cæsia, for 39+8, or 47 parts of potash, he found that the quantities of the different constituents furnished by 100 parts of the mineral yielded by their addition the full sum of 100 parts required.

* Read before the Royal Institution of Great Britain.

* For some qualifications of this statement, *vide* Roscoe's "Spectrum Analysis."

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In submitting to spectroscopic examination a certain residue left by the distillation of some impure selenium, Mr. Crookes, early in 1861, recognised in the spectrum before him a brilliant green line, from which he inferred the presence in the above residue of a new element; and by the end of the same year, he had succeeded in establishing the tolerably wide distribution of this element, to which he gave the name of thallium; in procuring it, though but in small quantity, in a separate state; and in satisfying himself of its metallic character. Soon afterwards, and without knowledge of Mr. Crookes's later results, the metal was obtained by M. Lamy on a comparatively large scale, and was exhibited by him in the form of small ingots at the London Exhibition of 1862. He procured it from the fine dust met with in some oil of vitriol factories, as a deposit in the flues leading from the pyrites burners to the leaden chambers. In these deposits, the minute proportion of thallium contained originally in the pyrites becomes concentrated, so as to form in some instances as much as 8 per cent by weight of the dust. Independently, moreover, of its occurrence in iron pyrites, thallium, though never forming more than a minute constituent of the different minerals and mineral waters in which it occurs, is now known to be capable of extraction from a great number and variety of sources. But from no other source is it so advantageously procurable as from the above-mentioned flue deposit; and so early as the autumn of 1863, at the meeting of the British Association in Newcastle, the then mayor, Mr. I. Lowthian Bell, exhibited several pounds, and Mr. Crookes no less than a quarter of a hundredweight of thallium obtained from this comparatively prolific source. In one respect, the discovery of thallium presented even a greater degree of interest than attached to the discovery of cæsium and rubidium. For whereas these two elements were at once recognised as analogues of the well-known metal potassium, thallium can hardly be said, even at the present time, to be definitely and generally recognised by chemists as the analogue of any particular metal, or as a member of any particular family of elements. With each of such differently characterised elements as potassium, lead, aluminum, silver, and gold, it is associated by certain marked points of resemblance; while from each of them it is distinguished by equally well-marked points of difference. Hence the necessity for subjecting thallium and its salts to a thorough chemical examination, so as to accumulate a well-ascertained store of facts with regard to it. And thanks to the careful labours of many chemists, more particularly of Mr. Crookes in London, and of Messrs. Lamy and Willm in Paris, our knowledge of the properties of thallium and of its salts may compare not unfavourably with our similar knowledge in relation to even the longest known of the metallic elements. Still it was not until our knowledge of indium had culminated in the determination of its specific heat only last year, that the position of thallium as an analogue of indium, and a member of the aluminum family of elements became unmistakably evident.

Indium was first recognised in 1863, by Drs. Reich and Richter, in the zinc blende of Freiberg in Saxony, and by reason of the very characteristic spectrum afforded,—consisting of two bright blue or indigo bands; the brightest of them somewhat more refrangible than the blue line of strontium, and the other of them somewhat less refrangible than the indigo line of potassium. Since its first discovery, indium has been recognised in one or two varieties of wolfram, and as a not unfrequent constituent of zinc ores, and of the metal obtained therefrom, but always in a very minute proportion. Indeed, indium would appear to be an exceedingly rare element, far more rare than its immediate predecessors in period of discovery. Its chief source is metallic zinc,—that of Freiberg, smelted from the ore in which indium was first discovered, containing very nearly one-half part of indium per 1000 parts of zinc. A considerable quantity of indium extracted from this zinc was shown in the Paris Exhibition of 1867; and an ingot from the Freiberg Museum, weighing 200 grms., or over 7 ounces, has within the last few days been kindly forwarded by Dr. Richter himself, for inspection on the present occasion. To Dr. Schuchardt, of Goerlitz, also, the members of the Institution are indebted for his loan of nearly 60 grms. of metallic indium; and of fine specimens of other rare chemical products, prepared with his well-known skill, in a state of great purity and beauty.

When zinc containing indium is dissolved not quite completely in dilute sulphuric or muriatic acid, the whole of the indium originally present in the zinc is left in the black spongy or flocculent residue of undissolved metal, with which everyone who has prepared hydrogen gas by means of zinc and acid is so well acquainted. Besides some zinc, this black residue is found to contain lead, cadmium, iron, and arsenic, less frequently copper and thallium, and in some cases, as that of the Freiberg zinc, a small proportion of indium. From the solution of this residue in nitric acid the indium is separated by ordinary analytical processes, based chiefly on the precipitability of its sulphide by sulphuretted hydrogen from solutions acidulated only with acetic acid; and on the precipitability of its hydrate both by ammonia and carbonate of barium. From its soluble salts, metallic indium is readily thrown down in the spongy state by means of zinc. The washed sponge of metal is then pressed together between filtering paper, by aid of a screw press, and finally melted under a flux of cyanide of potassium.

Thus obtained, indium is a metal of an almost silver-white colour, apt to become faintly bismuth-tinted. It tarnishes slowly on exposure to air, and thereby acquires very much the appearance of ordinary lead. Like lead, it is compact and seemingly devoid of crystalline structure. Moreover, like lead and thallium, it is exceedingly soft, and readily capable of furnishing wire, by the process of "squirting" or forcing. The specific gravity of indium, or 7·4, is very close to that of tin, or 7·2; and much above that of aluminum, 2·6, and below that of lead, 11·4, and that of thallium, 11·9. In the lowness of its melting-point, viz., 176° C., indium occupies an extreme position among the metals permanent in air; the next most fusible of these metals, viz., tin and cadmium, melting at 228°, bismuth at 264°, thallium at 294°, and lead at 335°. Though so readily fusible, indium is not an especially volatile metal. It is appreciably less volatile than the zinc in which it occurs, and far less volatile than cadmium. Heated as far as practicable in a glass tube, it is incapable of being raised to a temperature sufficiently high to allow of its being vapourised, even in a current of hydrogen.

Indium resists oxidation up to a temperature somewhat beyond its melting-point, but at much higher temperature it oxidises freely; and at a red heat it takes fire in the air, burning with a characteristic blue flame and abundant brownish smoke. It is readily attacked by nitric acid, and by strong sulphuric and muriatic acids. In diluted sulphuric and muriatic acids, however, it dissolves but slowly, with evolution of hydrogen. Oxide of indium is a pale yellow powder, becoming darker when heated, and dissolving in acids with evolution of heat. The hydrated oxide is thrown down from indium solutions by ammonia as a white, gelatinous, alumina-like precipitate, drying up into a horny mass. The sulphide is thrown down by sulphuretted hydrogen as an orange-yellow precipitate, insoluble in acetic, but soluble in mineral acids. The hydrate and sulphide of indium, in their relations to fixed alkali solutions more particularly, seem to manifest a feebly-marked acidulous character. Chloride of indium, obtained by combustion of the metal in chlorine gas, occurs as a white micaceous sublimate, and is volatile at a red heat without previous fusion. The chloride itself undergoes decomposition when heated in free air, and the solution of the chloride upon brisk evaporation, with formation in both cases of an oxychloride.

(To be continued).

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ON THE

PART WHICH FERRIC AND ALUMINIC OXIDES PLAY IN THE MANUFACTURE OF SUPERPHOSPHATE;

AND ON THE

COMPARATIVE VALUE OF MINERAL PHOSPHATES.*

By T. L. PATTERSON, F.C.S.

As the consumption of phosphatic minerals in the production of artificial manures has increased to an enormous extent of late years, so it becomes a matter of the greatest importance that manufacturers should study carefully the influence of the several constituents of the raw material on the production of the manufactured article. At present, importance is only attached to the per cent of tricalcic phosphate in mineral phosphates, without regard to the other ingredients; in so much so, that most of them are purchased at a certain fixed rate for each per cent of this earth shown in an analysis. I will attempt, however, to show that it is equally important for manufacturers to know the per cent of calcic carbonate, ferric oxide, and aluminic oxide, as well as how they are combined, to enable them to judge correctly what is the value of any mineral phosphate for the manufacture of manure.

As I believe a phosphatic mineral is only valuable for the superphosphate which can be made from it, I intend treating the subject from what I may call a decomposition point of view; and in the first part of this paper will discuss the reactions which take place when sulphuric acid is added to a mineral phosphate containing ferric and aluminic oxides, and describe some experiments in support of them. In the second part, I will show how the comparative value of these phosphates may be calculated.

The following are the analyses of three minerals, well known in commerce, which illustrate very well all the points I wish to bring before the section:—

	No. 1.	No. 2.	No. 3.
Phosphate of lime	50·90	54·25	51·67
Phosphate of magnesia ..	a little	0·55	0·35
(= phosphate of lime) ..	—	(0·77)	(0·49)
Calcic carbonate existing partly as calcic fluoride and chloride	9·64	24·47	14·55
Calcic sulphate	1·72	2·57	4·03
Ferric oxide	6·96	2·03	1·06
Ferrous oxide	—	0·34	0·42
Aluminic oxide	4·18	1·75	0·89
Silica and sand	18·44	8·62	17·21
Loss on ignition	3·97	4·37	5·45
Loss at 100° C.	3·75	1·08	4·00
	99·56	100·03	99·63

When sulphuric acid is added to a phosphate such as No. 1, in quantity insufficient to render all the bases soluble, double decompositions represented by some or all of the following equations will be the result. To avoid complexity, I will not include the water of hydration:—

(*a*). $CaCO_3+SO_3=CaSO_4+CO_2$.
(*b*). $Ca_3(PO_4)_2+2SO_3=Ca(PO_3)_2+2CaSO_4$.
(*c*). $Fe_2O_3+3SO_3=Fe_2O_3.3SO_3$; and
(*d*). $Fe_2O_3.3SO_3+Ca(PO_3)_2=2FePO_4+CaSO_4+2SO_3$,

or—

(*e*). $Fe_2O_3.3SO_3+Ca_3(PO_4)_2=2FePO_4+3CaSO_4$, or
(*f*). $3(Ca(PO_3)_2)+2Fe_2O_3=4FePO_4+Ca_3(PO_4)_2$, and
(*g*). $4FeSO_4+O_2+Ca(PO_3)_2+Ca_3(PO_4)_2=4FePO_4+4CaSO_4$.

Equations (*a*) and (*b*) are well-established, and need no comment. Calcic fluoride will be decomposed in the same way as calcic carbonate, and is therefore represented by (*a*). I have not shown the calcic fluoride separately in the foregoing analyses, because, for the purposes of the manufacturer, it is unnecessary; and the small amount of silicon carried off by the liberated hydric fluoride is of no importance in the after calculation. The estimation of fluorine, too, is difficult and tedious when present in small quantity; and, since it serves no useful purpose, it seems to me preferable to report the calcium existing as fluoride as calcic carbonate, for, so far as the calcium is concerned, the ultimate result is the same.

The peroxide of iron and alumina will be attacked simultaneously with the phosphate and carbonate of calcium, &c., and so we might expect to have neutral persulphate of iron and neutral sulphate of alumina, or still more acid salts, formed according to equation (*c*), which in their turn react on a portion of the monocalcic phosphate just become soluble, according to equation (*d*), setting free two molecules of sulphuric acid to attack a still untouched portion of tricalcic phosphate. Or, again, we may assume that the reaction represented in equation (*e*) takes place, where a molecule of ferric sulphate decomposes one of tricalcic phosphate, with the production of two of ferric phosphate and three of calcic sulphate. Or, lastly, we may suppose, with Graham and Fresenius, that the acid attacks the calcic carbonate and phosphate in the first instance, then the soluble monocalcic phosphate gradually reacts on ferric and aluminic oxides, producing in the course of time the so-called "reduced phosphates," as represented by equation (*f*), where three molecules of monocalcic phosphate are decomposed by two of ferric oxide into four of ferric phosphate and one of tricalcic phosphate.

Ferrous oxide when present simply replaces lime; but in the course of time, as it gradually absorbs oxygen, a portion of monocalcic phosphate will be precipitated, as shown in equation (*g*).

No single one of these equations, however, in my opinion, represents exactly the true decomposition of a mineral phosphate on the addition of sulphuric acid. Yet I think two or more of them are sufficient to do so. The ferric and aluminic oxides exist partly in a hydrated and partly in an anhydrous condition, or, at any rate, one portion seems to be more hydrated than another. It is thus likely that equations (*c*) and (*d*), (*c*) and (*e*), or (*c*), (*d*), and (*e*), represent actions which take place simultaneously with those represented by (*a*) and (*b*), the hydrated oxides of iron and aluminium taking part in the reaction; and afterwards, when the resulting superphosphate is kept for some time, the decomposition represented in equation (*f*) takes place, through the action of a portion of the oxide of iron and alumina which remained unattacked in the process of manufacture. The following experiments were made in order, if possible, to throw some light on the decomposition of these minerals:—

Expt. 1.—A portion of No. 2 phosphate had a red colour after ignition, while superphosphate made from it, subjected to the same treatment, had a light grey colour. This was also the case with No. 1 phosphate, and shows that, whatever be the reaction, the ferric oxide was not combined with phosphoric acid in the mineral, while it was in the superphosphate.

Expt. 2.—A sample of another phosphate which gave 10·52 per cent of ferric and aluminic oxides and 18·90 per cent of sand, when digested with dilute HCl, yielded *after ignition* only 5·79 per cent of these oxides to the acid solution, and the residue weighed 23·26 per cent. When this residue was boiled with HNO_3, and the solution tested with molybdate of ammonia, it was found free from phosphoric acid. The residue of the ignited portion was 4·36 per cent in excess of that of the mineral before ignition. And 4·36+5·79=10·15, a result closely corresponding with the percentage of ferric and aluminic oxides found in the non-ignited mineral. Now it is well known that hydrates of these oxides are less soluble after than before ignition, and this experiment shows that they were

* Read before the Chemical Section of the Glasgow Philosophical Society.

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present in this mineral in that form. As all these minerals lose weight on ignition, over and above what they lose at 100° C., we may assume that the loss is principally water of hydration, and that it is in combination with iron and aluminium oxides. (Some of them contain organic matter, which is also driven off on ignition, but it usually exists only in small quantity. It seems, however, to exert a reducing action on the ferric oxide, retaining a portion in the condition of ferrous oxide. Nos. 3 and 2, which contain most organic matter, have also most ferrous oxide, and No. 1, having little more than a trace, contains none of that oxide).

Expt. 3.—When a portion of any of these minerals, but especially No. 1, which contains most ferric and aluminic oxides, was digested with a solution of citrate of ammonia of 1·09 sp. gr. for about an hour on the top of the water-bath, and filtered, the filtrate had a very yellow colour, owing to the solution of a portion of the red oxide of iron. All the iron is not rendered soluble by this treatment, as the residue still remains coloured. This is, doubtless, due to the intimate admixture of the molecules of ferric and aluminic oxides with the other ingredients of the mineral, so that it would be practically impossible to separate the whole of these oxides by this means. That a portion is attacked, however, and goes into solution, is another proof, I think, that they exist—partly, at least,—in the hydrated form.

Expt. 4.—A mineral phosphate was dissolved with excess of dilute sulphuric acid, water added, and the whole thrown on a filter. To the filtrate, which contained ferric and aluminic oxides, ammonia was added, until a permanent precipitate was formed. The precipitate was filtered off, and the filtrate, which was now in the most neutral condition possible, was used to make further experiments.

Expt. 5.—To a portion of the filtrate from Expt. 4, pure tricalcic phosphate was added. The clear solution filtered from this mixture gave abundant evidence of iron with ferrocyanide of potassium; but, after standing some days, the filtrate only showed a minute trace of that metal when tested with the ferro- and sulpho-cyanides of potassium. The ferric sulphate in the original solution is thus shown to have decomposed a portion of the tricalcic phosphate, with production of ferric phosphate and calcic sulphate, as represented in equation (*e*).

Expt. 6.—To a second portion of the same solution was added a solution of alumina ammonia alum, but even after standing some days it remained quite clear. Pure precipitated tricalcic phosphate was now added. After the lapse of eight or ten days, the mixture was filtered, and tested with ammonia and acetic acid; an abundant precipitate of aluminic phosphate was obtained. When the solution was boiled with tricalcic phosphate filtered and tested as before, a much less abundant precipitate was obtained. Thus we see that although neutral phosphate of calcium cannot remove alumina from a solution in the cold, yet it does so to a great extent when heated.* And, as all superphosphate becomes highly heated in the process of its manufacture, this reaction explains the reason why so little aluminic oxide is found in an aqueous extract. Its precipitation in this way is doubtless similar to that of ferric oxide as represented in equation (*e*).

Expt. 7.—To a third portion of the filtrate from Expt. 4 was added a solution of ferric ammonia alum, this being probably one of the most neutral salts of that base. The mixture remained quite clear at first, but in the course of a minute a white flocculent precipitate separated, which gradually increased on standing for some hours. Warington has already shown that the addition of an alumina salt to a solution of phosphoric acid gives no precipitate in the cold, while a precipitate goes down at once when the aluminic solution is replaced by a ferric one.* This difference between aluminic phosphate and ferric phosphate shows that the latter salt requires a greater excess of acid to retain it in solution than the former. On this account, I thought it would be interesting to determine the composition of the precipitate formed; accordingly I prepared a small portion, filtered and washed it thoroughly in the cold, and dried it in the water-bath.

0·4248 grm. lost 0·0820 grm. on ignition,
0·4248 ,, gave 0·1712 ,, Fe_2O_3, and
0·3275 ,, gave 0·2083 ,, $2MgO,P_2O_5$.

The ferric oxide was estimated with $\frac{N}{10}$ chromate of potash, after reduction with zinc, and the phosphoric acid by the molybdate process. Calculated to per cent the results are as follows, and correspond to the formula $7Fe_2O_3,8P_2O_5$.

	Calculated from the formula $7Fe_2O_3,8P_2O_5$.	Found.
Ferric oxide	40·21	40·30
Phosphoric anhydride ..	40·79	40·70
Loss on ignition	—	19·31
		100·31

When this acid phosphate of ferric oxide is digested with the citrate of ammonia solution at 38° C. it goes easily into solution, as might be expected from the known solvent power of citric acid salts for those of ferric oxide. Whether this phosphate is formed in the manufacture of superphosphate remains to be proved. It seems very probable that a small quantity is produced simultaneously with ferric phosphate; but, if it is, it is hardly possible for it to exist long as such, for the tricalcic phosphate present will soon decompose it and bring it back to its normal state.

Expt. 8.—To a fourth portion of the solution from Expt. 4 was added a solution of the double sulphate of protoxide of iron and ammonia. It remained perfectly clear for a couple of hours, when it began to be turbid, and after standing over night a considerable precipitate had separated. When this precipitate was filtered off, washed, and tested with ferricyanide of potassium, it was found perfectly free from ferrous oxide. The ferric phosphate which separated was doubtless formed as represented in equation (*g*).

Expt. 9.—To a fifth portion of the same solution I added a quantity of well-washed hydrated ferric oxide. But little change was observed for a day or two; gradually, however, the solution became opalescent, especially the supernatant fluid, when the red oxide had collected at the bottom of the glass, and the red ferric oxide became of a lighter colour. These indications of decomposition were greater after the lapse of eight or ten days; and at the end of a month they were very evident, as the ferric oxide slowly and gradually precipitated the phosphoric acid, as represented in equation (*f*). A portion of the solution removed by filtration still gave abundant evidence of the presence of phosphoric acid.

Fresenius refers to another decomposition to account for the reduced phosphates. He supposes one molecule of monocalcic phosphate to react on one of tricalcic phosphate, with the production of two of dicalcic phosphate, thus:—

$$Ca_3(PO_4)_2 + Ca(H_2PO_4)_2 = 2(Ca_2(HPO_4)_2);$$

but no experiments being given in support of this hypothesis, and as the presence of ferric and aluminic oxides are sufficient to account for all the phenomena observed, I cannot regard this decomposition as at all probable. Now it follows, from what I have said, that all superphosphates which contain these oxides should also contain reduced phosphates. Chemists have tried to estimate them as though they were precipitated tricalcic phosphate. If a superphosphate be analysed when it is made,

* I was unaware of the following statement in Storer's "Dictionary of Solubilities," when the above experiments were made. At p. 483 he says:—"Any insoluble (*c*) phosphate of a protoxide is completely decomposed by any soluble salt of a sesquioxide, as an alum, for example, either in the cold or at the boiling temperature, an insoluble salt of the sesquioxide being formed."

* Chemical News, vol. xxiii., p. 205.

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ain at the end of twelve months or so, the phos- acid which has become insoluble during that period at can properly be called "reduced." Yet the best which has been devised for their estimation is of removing from a superphosphate more than I happen to have had beside me for some years amples of superphosphate, which were analysed at e they were made. With the object, therefore, of the process, I have again subjected them to s, this time estimating the reduced phosphates by ius, Neubauer, and Luck's method, in which a solution of citrate of ammonia of 1·09 sp. gr. is as described by them in a paper "On the Best ds for the Analysis of Mineral Phosphates and Arti- fanure."* The following are the results:—

	Sample No. 1.		Sample No. 2.		Sample No. 3.	
	a.	*b.*	*a.*	*b.*	*a.*	*b.*
e phosphate	22·05	19·60	16·61	14·21	20·66	18·01
ble ,,	9·63	6·32	12·42	8·17	6·70	3·91
ed ,,	—	5·90	—	7·05	—	4·61
Total ..	31·68	31·82	29·03	29·43	27·36	26·53

the composition of the superphosphate when made; same recently ascertained.

1 is a sample of 190 tons made in October, 1868.
2 ,, ,, 70 ,, ,, December, 1868.
3 ,, ,, 75 ,, ,, January, 1869.

se samples have thus lain in my possession for up- of three years, during which period they have gone n soluble phosphate of lime to the extent of—

2·45 per cent in No. 1 sample.
2·40 ,, No. 2 ,,
2·65 ,, No. 3 ,,

we see that the so-called "reduced phosphates" ry much greater when estimated by this indirect d than is represented by the difference of the soluble ic phosphate in the superphosphates at the time were made, and that found in them after the lapse ee years. The citrate of ammonia filtrate comes highly coloured with iron, because it has dissolved phosphate; it has also removed aluminic phosphate ll the calcic sulphate. The insoluble residue still ins phosphoric acid, ferric oxide, and aluminic oxide, s in these samples it contained no lime, the phos- acid must have been in combination with the iron luminic oxides. If, then, as I have just shown, the solution removes more phosphoric acid than is ented by the actual going back of the superphosphate ee years, the indirect method giving a much higher tage for these phosphates than it ought, it is quite table for their estimation. If, on the other hand, we understand as reduced phosphates all phosphoric hich has combined with ferric and aluminic oxides process of manufacture—there being no phosphoric combination with these oxides in the raw material, it is all combined in superphosphate; and if, more- it be admitted that these reduced phosphates are pally ferric and aluminic phosphates, and not neutral ate of lime, it is again apparent that the citrate n cannot be used to separate them, as it failed to ve all the ferric and aluminic phosphates contained insoluble residue from the three samples above d.

reduction of these superphosphates may be ex- d by some of the equations given above. The solution of an artificial manure seldom contains than a trace of ferric and aluminic oxides, even newly made, so that the 2·45 per cent gone back in No. 1, for example, could not have been the result decomposition such as (*d*), but it is highly probable phate formed in the way represented by equation (*f*). Thus oxide which the mineral contains would, of course, also reduce a portion of the phosphoric acid as represented in (*g*); but, in any case, only one-third of the phosphoric acid reduced exists as tricalcic phosphate, the remainder being ferric and aluminic phosphates. The residue of the reduced phosphates in sample No. 1 (5·90 − 2·45 = 2·45) was in all probability never soluble at all, it having been produced in the process of manufacture according to equations (*c*), (*d*), and (*e*) together, or (*c*) and (*e*) alone.

Summarising what I have said, we see in the first place that, when a mineral phosphate is mixed with sulphuric acid, the ferric and aluminic oxides, which were originally present in the form of hydrates, become partially converted during the reaction, and completely after the lapse of an indefinite period, into the insoluble phosphates of these oxides; and lastly, that the so-called "reduced phosphates" consist principally of a portion of the phosphates so formed.

This brings me to the second part of my paper.

(To be continued).

* Frenzius, *Zeitschr.*, Vol. 2., part 2.

ON SOME PROPERTIES OF CHLORAL HYDRATE.

By Dr. T. L. PHIPSON, F.C.S.

When chloral combines with water to form the solid hydrate of chloral it gives out a considerable amount of heat, but when hydrate of chloral dissolves in water, a very considerable degree of cold is produced. Half a pound of chloral hydrate mixed rapidly with half a pound of water causes the thermometer to sink many degrees below zero.

The crystalline form of pure chloral hydrate is the *oblique rhombic prism*, and the crystals are usually very neat. When these prisms are short, which is frequently the case, they may easily be mistaken for acute rhombohedra.

When minute fragments of the crystals remain suspended on the surface of pure distilled water, they move about rapidly, with the same peculiar gyratory motion that is remarked with camphor in the same circumstances.

NOTE ON THE ESTIMATION OF SULPHUR IN PYRITES.

By H. B. YARDLEY.

It is usual, in oxidising the pyrites with nitric acid, after the first violent action is over, to heat the solution in a flask having a small funnel inserted in the mouth on the sand-bath, to brisk ebullition. The high temperature thus employed, I have been told, causes a loss of sulphur and consequent incorrect result.

To prevent this *supposed* loss, some chemists oxidise the pyrites in a small covered beaker, at a lower temperature, on the water-bath.

Having doubts as to any difference in determinations by each process, I made the four following analyses:—

No. 1.—16·86 grs. oxidised at 212° gave 59·02 grs. $BaSO_4$, containing 8·09 sulphur = 47·86 per cent sulphur.

No. 2.—17·65 grs. oxidised at high temperature (undetermined and varying) gave 61·92 grs. $BaSO_4$, containing 8·49 grs. sulphur = 48·10 per cent sulphur.

No. 3.—15·35 grs. oxidised at 212° gave 1·30 unoxidised sulphur (or H_2O retained at 212°) and 11·62 $BaSO_4$, containing 1·59 sulphur: total sulphur 1·89 = 12·31 per cent, or 1·59 = 10·35 per cent.

No. 4.—15·15 grs. oxidised at high temperature gave 0·45 gr. unoxidised sulphur (or H_2O retained at 212°) and 10·83 $BaSO_4$, containing 1·52 sulphur: total sulphur 1·97 = 12·34 per cent, or 1·52 = 10·03 per cent.

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Nos. 1 and 2 were of the same sample of *raw ore*, and Nos. 3 and 4 of the same sample of *cinders*. The difference in Nos. 1 and 2 is only 0·24 per cent, and Nos. 3 and 4 0·03 per cent, both on the side of high temperature, or, if the *unoxidised sulphur* was in reality H_2O retained by insoluble matters at 212°, 0·32 per cent for low temperature. All these differences, however, would be considered immaterial for commercial purposes, and are excessive for experimental purposes. I therefore come to the conclusion that no loss is occasioned by the use of a high temperature, although I have found that the low temperature, improbable as it may seem, takes less time. Just sufficient HNO_4 is added for oxidation of the sulphur, and after a half-hour's heating on the water-bath enough HCl is mixed with it to dissolve the iron, &c., and no evaporations are necessary. The precipitate of $BaSO_4$ also subsides more readily than in the other case, almost allowing the clear supernatant liquid to be poured off without filtering.

NOTES OF WORK BY STUDENTS OF PRACTICAL CHEMISTRY IN THE LABORATORY OF THE UNIVERSITY OF VIRGINIA.

Communicated by J. W. MALLET, Ph.D., M.D.,
Professor of Analytical and Applied Chemistry, University of Virginia.

(1). *Composition of the Precipitate formed by adding a Solution of Ammonio-Sodic Phosphate to one of Calcic Chloride.* Examined by Mr. J. W. C. DAVIS, of Westmoreland Co., Va.

On adding to a cold moderately-concentrated solution of calcic chloride a solution of "microcosmic salt," as long as a precipitate was formed, this precipitate was found to be at first flocculent, but on standing in the supernatant fluid for twenty-four hours it became distinctly crystalline, some of the individual crystals attached to the sides of the beaker being large enough to be distinguished by the naked eye. They were colourless and transparent, and under the microscope the form was seen to be that of thin rhombic tables with plane angles of 30° and 150° respectively, the acute angles being often truncated by short planes, with plane angles as in the Figure. The precipitate was placed upon a filter, partially washed with a small quantity (not much more than its own volume) of water, a portion (A) in this condition set aside for analysis, and the remainder (B) thoroughly washed until the wash-water ceased to give any indication of the presence of chlorine, and until argentic nitrate showed but a very faint trace of phosphoric acid, which did not seem further to diminish. This latter washing lasted about two weeks, and about 5 litres of water were passed through some three grms. of the precipitate.

The partially washed portion (A) yielded, on analysis—

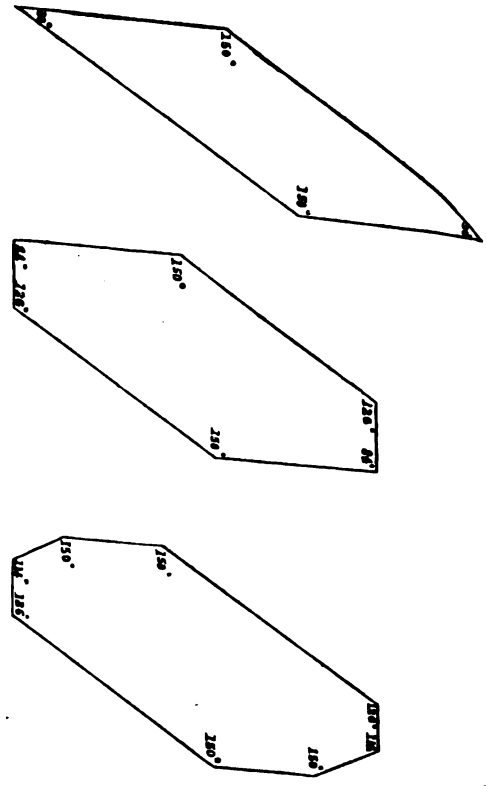
Phosphorus pentoxide	40·00
Lime	32·28
Chlorine	1·20
Water	27·05
Soda and ammonia	traces

Or—

Phosphorus pentoxide	40·00
Lime	31·34
Calcium chloride	1·87
Water	27·05
	100·26

Of the water, 20·05 per cent was given off by heating up to 55° C., 1·85 per cent between 140° and 250°, and 5·15 per cent was retained until the temperature ranged from 250° to a red heat.

If the calcium chloride be assumed to have had associated with it the most usual amount of water of crystallisation ($CaCl_2+6H_2O$), and be deducted from the above results of analysis, there will remain the dicalcic ortho-phosphate



with four equivalents of water ($Ca_2H_2P_2O_8+4H_2O$), described by Raewski, Bödeker, and Drevermann, as the following statement shows:—

	Found.	Calculated.
Phosphorus pentoxide	41·03	41·28
Lime	32·15	32·56
Water	26·82	26·16
	100·00	100·00

The thoroughly-washed portion (B) dried, like the above, over oil of vitriol at ordinary temperature, yielded, on analysis—

Phosphorus pentoxide	39·88
Lime	34·02
Water	25·25
	99·15

indicating a small loss of phosphoric acid, and relative increase of lime, but affording essentially the same formula as at first. Examined with the microscope, the crystals were still transparent and unchanged in appearance, except by the angles having been more or less broken off.

(2). *Composition of Crystalline Deposit from a Solution of Magnesium and Ammonium Chloride.* By Mr. J. W. C. DAVIS.

A bottle containing magnesium and ammonium chloride (with excess of ammonia), prepared for use as a laboratory reagent, was found, after standing undisturbed for some months, to have become crusted on the inside with a white crystalline deposit, which under the microscope appeared as bunches of slender, colourless needles, radiating from the centres of the tufts....

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Two specimens (A and B) were washed upon filters with cold water; A with a small quantity only, but enough to remove all ammonia and ammoniacal salt; B with a very much larger quantity, the washing being continued for several days until nothing more could be dissolved out.

The mean of three analyses of A proved it to be magnesium oxychloride, and afforded—

Magnesia	45·41
Chlorine	12·97
Loss on heating to redness	53·50
Or—	
Magnesium chloride	17·36
Magnesia	38·10
Water	43·45
	98·91

It was ascertained that the material, heated gradually to redness and kept red-hot for some time, only retained 0·0014 per cent of chlorine; in place of the chlorine driven off, oxygen had of course been taken up from the air.

The loss of weight on heating occurred at a pretty uniform rate between 65° and 225° C.

The analysis corresponds best to the formula $MgCl_2+5MgO+13H_2O$, which would require—

Magnesium chloride	17·96
Magnesia	37·81
Water	44·23
	100·00

Perhaps this may be assumed as—

$$Mg_2Cl_2O,H_2O+4(MgO,3H_2O).$$

The more complex formulæ deduced by C. Bender* for Sorel's magnesian cement were obtained from the analysis of a material which does not seem to have been crystalline, and which contained magnesium carbonate.

The substance (B), thoroughly exhausted by washing with cold water, and air-dried, had lost distinctness of crystalline form and was found to contain no chlorine. It was a magnesian hydrate, and yielded results intermediate between those of the simple formula MgO,H_2O, and of the formula found by Bender (*loc. cit.*), viz., $4MgO,5H_2O$.

	Found.	Calculated (MgO,H_2O).	Calculated ($4MgO,5H_2O$.)
Magnesia	66·33	68·96	64·00
Water	33·67	31·04	36·00
	100·00	100·00	100·00

In all probability the merely air-dried material retained a little non-essential water, and the former of these formulæ really represents the substance as obtained from the source now in question.

(3). *Analysis of an Anomalous Variety of Stannite (Tin Pyrites) from Cornwall.* By Mr. J. B. Adger, of South Carolina.

A specimen of "bell-metal ore" from Cornwall, massive, but apparently very uniform in character, of steel-grey colour inclining to yellowish-grey, with metallic lustre, finely granular fracture, and specific gravity = 4·46 at 12° C., was analysed with the following results, leading very distinctly to the formula $8(CuFeZn)S+3SnS_2$, instead of the usual $2(CuFeZn)S+SnS_2$.

		Percentage divided by atomic weight.		
Sulphur ..	27·945	0·8733		14·00
Tin	22·037	0·1868		2·99
Copper	27·771	(0·4373÷2) = 0·2186	0·5020	8·05
Iron	12·749	0·2277		
Zinc	3·618	0·0557		
Insoluble (quartz)	6·390			
	100·510			

* *Ann. d. Chem. u. Pharm.*, clix., 341.

One would be inclined to suspect the (not uncommon) intimate admixture of normal stannite with copper pyrites, were it not for a want of sulphur enough to meet this view, and the very close accordance of the figures actually obtained with the above irregular formula. There were some small fragments of copper pyrites attached to a part of the specimen, but they were plainly distinguishable, and easily picked out.

The only other accompanying mineral was wolfram.

(4). *Composition of the Deposit from Retorts in which Carbon Disulphide had been made.* By Mr. F. P. Dunnington, of Baltimore.

A specimen of the deposit, or rather crust, removed from cast-iron retorts in which the manufacture of carbon disulphide had been carried on at the establishment of Mr. Jesse Fisher, Phœnix Chemical Works, Ironbridge, (England), presented the appearance of a nearly black mass, with traces of bronze-yellow colour, of about 33 m.m. thick, divisible by the eye into three tolerably distinct but closely united layers, of which that (No. 1) which had obviously been in contact with the iron was about 6 m.m. thick, granular in fracture, pretty compact, of black colour, and imperfect metallic lustre; the middle one (No. 2) about 10 m.m. thick, very finely granular in fracture, still more compact, of dark blackish-grey colour, and imperfect metallic lustre; while the one (No. 3) which had been farthest from the iron, or nearest the interior of the cylinder was about 17 m.m. thick, distinctly crystalline, with slender prismatic structure (the long axes of the prisms at right-angles to the surface of the iron), less compact than either of the other two, of dark yellowish-grey colour, and distinct metallic lustre when freshly broken, most of the surface covered with an iridescent tarnish. The specific gravity, taken with the material in powder, and boiled with water to expel air, was found to be for No. 1, 3·69; for No. 2, 3·72; and for No. 3, 4·71.

All three were found to consist simply of sulphur and iron, the percentage of sulphur being—

In No. 1.	28·24
,, No. 2.	30·38
,, No. 3.	38·10

Hence the composition of the three layers may be represented as:—

	No. 1.	No. 2.	No. 3.	
Iron monosulphide ..	77·64	83·53	44·90	or 89·80
Iron	22·36	16·47	—	or —
Iron $\frac{1}{3}$-sulphide	—	—	55·10	or —
Iron disulphide	—	—	—	or 10·20
	100·00	100·00	100·00	100·00

The surplus metallic iron in Nos. 1 and 2 had undergone absorption by the sulphide, and was uniformly distributed through it, perhaps as Fe_2S or Fe_3S; no separate grains or particles of iron could be detected. The carbon of the iron seemed to have been completely removed.

(To be continued).

NOTICES OF BOOKS.

Lecture on Water. Delivered before the American Institute of the City of New York, in the Academy of Music, January 20th, 1871. By C. F. Chandler, Ph.D., Professor of Analytical and Applied Chemistry, School of Mines, Columbia College; Chemist to the Health Department of the City of New York. Albany: The Argus Company. 1871.

Dr. Chandler treats his subject in detail; and the lecture does not take that stereotyped form too common in scientific addresses. The lecture opens with a short account of the estimation in which water was held in earlier ages. We are told that the Hindoos and the Egyptians considered water the element from which all other bodies

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were formed. In later times, the idea was maintained that repeated evaporation converted water into earth. Lavoisier, in 1770, tested experimentally the question of the conversion of water into earth. It had long been known that when water was placed in a glass retort or alembic, and distilled, there remained behind a small quantity of earthy matter; and if the water was returned to the alembic, and distilled again, the quantity of earthy matter increased, and continued to increase as often as the water was distilled from it. It was supposed, therefore, that the water was gradually converted into earth. Lavoisier distilled three pounds of water again and again, in an alembic provided with a condenser, the whole apparatus being hermetically sealed, that not a particle of water should be lost. At the close of the experiment, he found that while the quantity of water had not diminished in the least, he had a residue of 20 grs. of earthy matter in the alembic. As the water had not diminished, he justly concluded that it had not come from the water; it must have been derived from the alembic itself. On cleansing the alembic and condenser, and weighing them, it was found that they had lost 17 grs. 17 grs. of the earthy matter had, therefore, been produced by the action of the boiling water on the glass. The remaining 4 grs. were attributed by Lavoisier to the natural impurities of the water. Scheele tested the same question, and not only proved that the earthy matter was derived from the glass, but analysed it, and found it to consist of the same constituents, potash, lime, and silica. Dalberg repeated the experiment in a silver vessel, and obtained no earthy matter. So the conversion of water into earth was proved to be a fallacy due to the action of the water upon the glass vessel.

Dr. Chandler incidentally shows that progress in chemistry has been chiefly within the last hundred years, or, rather, until that time but few correct ideas of the composition of ordinary substances were entertained; and he then passes on to consider the sources of water for domestic and for manufacturing purposes. Rivers, of course, are more likely to be charged with *suspended* impurities, for the reason that their waters, which have not been filtered through the soil, carry with them a certain quantity of clay and organic matter. The water of the Mississipi contains 40 grs. of mud per gallon; and it is estimated that this river carries 400,000,000 tons of sediment per annum into the Gulf of Mexico. The Ganges is said to carry down 6,368,000,000 cubic feet annually. This transportation of mud in suspension has produced large deposits at the mouths of these rivers. All of the State of Louisiana, and considerable portions of other States which border upon the lower Mississipi have been formed by the deposition of these sediments brought from higher levels.

Speaking of medicinal springs, Dr. Chandler gives an analysis of Congress Spring water, made in his own laboratory, with the assistance of Mr. F. A. Cairns, M.A.:—

"One United States gallon of 231 cubic inches contains:

Chloride of sodium	400·444 grs.
Chloride of potassium	8·049 ,,
Bicarbonate of magnesia	121·757 ,,
Bicarbonate of lime	143·399 ,,
Bicarbonate of lithia	4·761 ,,
Bicarbonate of soda	10·775 ,,
Bicarbonate of baryta	0·928 ,,
Bicarbonate of iron	0·340 ,,
Bicarbonate of strontia	a trace.
Bromide of sodium	8·559 ,,
Iodide of sodium	0·138 ,,
Sulphate of potassa	0·889 ,,
Phosphate of soda	0·016 ,,
Silica	0·840 ,,
Fluoride of calcium, Biborate of soda, Alumina	each a trace.
Total	700·895 grs.
Carbonic acid gas	392·289 cubic inches.

"A comparison of the above with the analysis made by Dr. John H. Steel, in 1832, proves that the Congress water still retains its original strength, and all the virtues which established its well-merited reputation.

"Its superior excellence is due to the fact that it contains, in the most desirable proportions, those substances which produce its agreeable flavour and satisfactory medical effects—neither holding them in excess, nor lacking any constituent to be desired in this class of waters.

"As a cathartic water its almost entire freedom from iron specially recommends it, many of the other springs contain so much of this ingredient as to seriously impair their usefulness."

Among medicinal springs are the sulphur waters of the White, Red, and Salt Sulphur Springs of Virginia, the White Sulphur Springs of Ohio, and the Richfield, Sharon, Chittewango, and Florida Springs of New York State, corresponding to the waters of Harrogate, Croft, and Aix-la-Chapelle. The sulphuretted hydrogen gives these waters a sweet taste and a very peculiar odour, which some consider offensive. These waters have, on analysis, yielded the following results:—

*Analyses of Sulphur Waters.**

In one U. S. Gallon of 231 cubic inches.	Chittenango, Madison Co., N. Y.		Florida, Montgomery Co., N.Y.
	White Sulphur spring.	Cave spring.	Magnesia spring.	Florida spring.
	Grs.	Grs.	Grs.	Grs.
Hydrosulphate of sodium (NaS,HS)	0·117	0·386	0·757	2·0800
Hydrosulphate of calcium (CaS,HS)	—	1·123	0·929	—
Sulphate of potassa	—	—	—	1·3900
Sulphate of soda	0·213	—	—	—
Sulphate of lime	81·420	106·126	115·085	—
Sulphate of strontia	trace	trace	trace	—
Sulphate of magnesia	1·953	7·589	18·718	—
Hyposulphite of soda	—	0·257	0·020	0·7100
Bicarbonate of soda ($NaO,HO,2CO_2$)	—	—	—	22·1400
Bicarbonate of lime	—	—	—	8·3700
Bicarbonate of magnesia	22·017	23·973	29·779	6·9200
Bicarbonate of iron	0·078	0·156	0·325	—
Chloride of potassium	0·156	0·233	0·333	—
Chloride of sodium	1·037	1·569	1·833	3·2800
Chloride of lithium	trace	trace	trace	—
Alumina	0·082	0·222	trace	trace
Silica	0·286	0·519	0·577	0·7900
Sulphur (in suspension)	trace	—	—	—
Sulphide of iron (in suspension)	—	—	—	0·1700
Total solid contents per gallon	107·359	142·113	153·356	43·3900
Total sulphur in the metallic sulphides and sulphuretted hydrogen.	0·339	1·397	2·400	1·9064

Cubic Inches of Gas per Gallon.

Sulphuretted hydrogen gas	0·884	2·754	5·623	3·7600
Carbonic acid gas	20·480	15·954	19·436	32·2600

With the exception of the hydrosulphate of sodium, hydrosulphate of calcium, hyposulphite of soda, sulphur, sulphide of iron, and sulphuretted hydrogen gas, the substances found in these waters are not essentially different from those contained in most spring waters; while to the sulphuretted hydrogen the peculiar odour is due, and to the action of the oxygen of the air on this gas the white milky turbidity arising from the freed sulphur.

Among the many curious springs occurring in Saratoga county is the High Rock spring. The Indian name *Saraghtoga* means *the place of salt*, and it was to the High Rock spring that the Indians, in 1767, bore Sir William Johnson. The spring rises on a little mound of stone, three or four feet high, which appears like a miniature volcano, except that sparkling water instead of melted lava flows from its little crater. Until quite recently, the water did not overflow the mound, but came to within a few inches of the summit, some other hidden outlet permitting it to escape. A few years ago, the property changed hands, and the new owners, convinced that by stopping the lateral outlet they could cause the water

* Made by Dr. Chandler, with the assistance of W. H. Chandler and F. A. Cairns, A.M.

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again to issue from the mouth of the rock, employed a number of men to undermine the mound, and with a powerful hoisting derrick to lift it off, and set it one side, that the spring might be explored. Just below the mound were found four logs, two of which rested upon the other two at right angles, forming a curb. Under the logs were bundles of twigs resting upon the dark brown or black soil of a previous swamp. Evidently some ancient seekers after health had found the spring in the swamp, and, to make it more convenient to secure the water, had piled brush around it, and then laid down the logs as a curb. The rock was formed by the water. It is composed of tufa, carbonate of lime, in the same manner as stalactites and stalagmites. As the water flowed over the logs, the evaporation of a portion of the carbonic acid caused the separation of an equivalent quantity of insoluble carbonate of lime, which layer by layer built up the mound. A fragment of the rock yielded, on analysis:—

Carbonate of lime	95·17
Carbonate of magnesia	2·49
Sesquioxide of Iron	0·07
Alumina	0·22
Sand and clay	0·09
Organic matter	1·11
Moisture	0·39
Undetermined	0·46
	100·00

"Below the rocks," continues Dr. Chandler, "the workmen followed the spring through 4 feet of tufa and muck. Then they came to a layer of solid tufa 2 feet thick, then 1 foot of muck, in which they found another log. Below this there were 3 feet of tufa; and there, 17 feet below the apex of the mound, they found the embers and charcoal of an ancient fire. By whom and when could the fire have been built? The Indian tradition went back only to the time when the water overflowed the rock; how many centuries may have elapsed since even the logs were placed in position? Calculations have been made by counting the layers of tufa, eighty-one being found to the inch, and the time since the fire was built has been fixed at 5,870 years; but, as I have seen half an inch of tufa formed in two years on a brick which received the overflow from a spout containing only 20 grains of carbonate of lime in a gallon, I am inclined to think our antiquarian's estimates are not entirely reliable."

After treating of chalybeates, acid, alum, borax, and siliceous waters, the lecturer proceeds to the discussion of the water supply for manufacturing purposes. He here embodies the results of numerous analyses of boiler incrustations in a table too copious for extraction. The removal of impurities by boiling, distillation, filtering, treatment with charcoal, permanganate of potash, &c., is next considered; but we must pass on to the simple statement of the characteristics of a good drinking water, which may be thus enumerated. The temperature should be at least 10° lower than the temperature of the atmosphere, but it should not be much lower than 45° F. It should be free from taste, smell, and of course should be transparent. "With regard," says the lecturer, "to the total quantity of impurities admissible in good drinking water, the sanitary congress which met at Brussels decided that water containing more than 35 grains of impurity in 1 gallon is not wholesome, and that there should not be much more than 1 grain of organic matter. Thirty-five grains is a large quantity for city water, though drainage-wells frequently contain more. The quality of the impurities is more important than the quantity. It is found that 5 or 6 grains of lime or magnesia render water unfit for the cooking of leguminous vegetables. On the other hand, it is a great advantage in making tea or coffee to use water of about 5° of hardness; that is, containing about 5 grains of carbonate of lime or its equivalent in the gallon. A person of very nice taste can tell the difference in tea or coffee made with water in which the difference is not more than 2 or 3 grains of lime or magnesia to the gallon. It is on this account that certain wells have a great reputation as 'tea wells.' In olden times there were two or three such wells in New York, and a boy was kept by the corporation to pump water for the benefit of the natives. The fine flavour of the tea made with such water is due to the fact that the 5 or 6 grs. of carbonate of lime prevent the water from dissolving the astringent matter contained in the tea, without interfering with the extraction of the theine and the other desirable constituents of the leaf. Magnesia in large quantities is objectionable, as are also lime salts; they are liable to cause dyspepsia. It is said that horses acquire a rough coat if supplied with water containing a large quantity of sulphate of lime. Goitre and cretinism are attributed to these impurities in the water. It is a curious fact that in Ireland, on the Waterford side of the Suir, where sandstones and slates prevail, goitre and cretinism are almost unknown; while on the Kilkenny side, where limestones abound, goitre is not uncommon. Perhaps the idiotic behaviour of those famous Kilkenny cats is attributable to the calcareous impurities of the water with which these unfortunate quadrupeds slaked their thirst."

Dr. Chandler has given much attention to the metallic impregnations of drinking waters. The most formidable is lead, from the action of the water on the lead pipes. Recently, the attention of the (New York) Metropolitan Board of Health having been called to the frequent cases of chronic lead poisoning which occurred in the city, Dr. Chandler was requested to investigate both the Croton water, and the various hair tonics, invigorators, and washes in common use, with a view to discovering the probable cause of the poisoning. The following contained grains of lead in one fluid ounce:—

Clark's Distilled Restorative for the Hair	0·11
Circassian Hair Rejuvenator	2·71
Professor Wood's Hair Restorative	3·08
Gray's Celebrated Hair Restorative	3·39
Phalon's Vitalia	4·69
Mrs. S. A. Allen's World's Hair Restorer..	5·57
Singer's Hair Restorative	16·39

Examinations were also made of Croton water which had been in contact with lead for different lengths of time, under usually occurring circumstances, of which the following are the results:—

(1). A gallon of Croton water from a lead-lined cistern, in which it had stood several weeks, was found to contain 0·06 grain of metallic lead.

(2). A gallon of water which had remained six hours in the lead pipes of a residence yielded 0·11 grain of metallic lead, a considerable portion of which was visible to the eye, in the form of minute white spangles of the hydrated oxycarbonate ($PbO,HO+PbO,CO_2$).

(3). Water drawn from one of the hydrants of the School of Mines' laboratory in the middle of the day, when the water was in constant motion, yielded traces of lead. This water reaches the school through about 100 to 150 feet of lead-pipe.

Certainly no pains should be spared to impress upon servants the importance of allowing the water to run for a few minutes before taking it for drinking or cooking purposes, especially early in the morning, after the water has stood all night in the pipes. The habit of filling the tea-kettle from the boiler, or of using water from the boiler for any purpose except washing, is very dangerous.

Few cities are more fortunate in the quantity and quality of their water supply than are New York and Brooklyn. The Croton water is brought to the city of New York by an aqueduct 45 miles long. Where the water enters the aqueduct a dam, 230 feet wide and 45 feet high, was erected in the Croton River, by which the Croton Lake was formed. This serves as a great reservoir, or sedimentary basin. The purity of the Croton water is remarkable; the following table shows the quan-

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tities of different substances obtained from one United States' gallon of 231 cubic inches:—

	Grains.
Soda	0·326
Potassa	0·097
Lime	0·988
Magnesia	0·524
Chlorine	0·243
Sulphuric acid	0·322
Silica	0·621
Alumina and oxide of iron	trace
Carbonic acid (calculated)	2·604
Water in bicarbonates (calculated)	0·532
Organic and volatile matter	0·670
Total	6·927
Less oxygen, equivalent to the chlorine	0·054
	6·873

These acids and bases are probably combined in the water as follows:—

Chloride of sodium	0·402
Sulphate of potassa	0·179
Sulphate of soda	0·260
Sulphate of lime	0·158
Bicarbonate of lime ($CaO,HO,2CO_2$)	2·670
Bicarbonate of magnesia ($MgO,HO,2CO_2$)	1·913
Silica	0·621
Alumina and oxide of iron	trace
Organic matter	0·670
Total	6·873

On evaporating a gallon of this water a residue of only 4·78 grains is obtained, the bicarbonates of lime and magnesia being left as simple carbonates.

The following tabular statement shows how favourably the Croton compares with the waters supplied to other cities:—

Impurities contained in One Gallon of 231 cubic inches, expressed in grains.

City.	Source.	Inorganic Matter.	Organic and Volatile Matter.	Total Solids.
New York	Croton, average for 13 weeks, 1867 (C. F. Chandler)	3·90	0·66	4·56
New York	Croton, average for 3 months, 1868 (C. F. Chandler)	3·31	1·14	4·45
New York	Croton, average for 6 months, 1869 (C. F. Chandler)	4·11	0·67	4·78
New York	Well west of Central Park (C. F. Chandler)	38·95	4·55	43·50
Philadelphia	Delaware (H. Wurtz)	2·93	0·55	3·48
London	Thames (Dr. H. Letheby)	15·55	0·83	16·38
London	Well, Leadenhall Street (Dr. H. Letheby)	90·38	9·59	99·97
Dublin	Lough Vartry, new supply (Apjohn and others)	1·77	1·34	3·11
Paris	Seine, above the City (Bussey, Wurtz, and Ville	7·83	1·00	8·83
Amsterdam	River Vecht (V. Baumhauer and V. Moorsel	14·45	2·13	16·58
Amsterdam	Deep well at the Keisersgracht	64·55	4·38	68·93

CORRESPONDENCE.

THE ATOMIC THEORY.

To the Editor of the Chemical News.

Sir,—We have heard much of late respecting the uselessness to the chemist of Dalton's theory. No believer in progression considers that the conception it affords of the constitution of matter is an absolutely true one. For upwards of half a century the theory has done incalculable service to chemistry, and remains still the guiding-star of that science. Every worker would hail with joy an attack on this simple but noble creation of a great mind, were the assailants armed with that resistless weapon—*experiment*. Phlogiston fell, as other theories have fallen, not by words, but by the sheer power of experiment. The anti-atomists should, therefore, follow the example set by Lavoisier, and attack what they consider so useless for mentally connecting experimental facts, and so injurious to scientific thought and progress, by the only means that can avail.—I am, &c.,

Alfred Tribe.

May 27, 1872.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, April 22, 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Method of Quantitatively Estimating Copper by means of Solution of Cyanide of Potassium.—De Lafollye.—Reserved for full translation.

Action of Sulphuric Ether on Iodides.—E. Ferrière.—When to a solution of any iodide in water there is first added some starch solution, and this mixture shaken up with sulphuric ether, the following phenomena are observed:—If the solution of the iodide is somewhat concentrated, a portion of iodine is set free, and the starch is coloured blue; if the solution is weak, this colouration only sets in after some three hours; if the solution is very dilute, the blue colouration only appears after some two or three days. When the blue-coloured starch is separated by filtration, and there is added to the filtrate another dose of ether, the blue colouration again appears, all the iodine being at last driven from its combination; chlorides and bromides are not thus acted upon. The author attributes this decomposition to the slow but continuous formation of an unstable iodhydric ether, (C_4H_5I), but the experimental proof of that reaction has not been found by him.

Synthesis of Orcin.—G. Vogt and A. Henniger.—By heating chlorated toluen, C_7H_7Cl, upon a water-bath, there are obtained two chloro-cresyl-sulphurous acids, $C_7H_6(Cl,SO_2H)$, which are converted into two isomeric acid baryta salts—

α-chloro-cresyl-sulphite of baryta, $(C_7H_6ClSO_3)Ba+2H_2O$.
β-chloro-cresyl-sulphite of baryta, $(C_7H_6ClSO_3)Ba+1\frac{1}{2}H_2O$.

The first-named of these salts, which is soluble in cold water, crystalline, and also soluble in boiling alcohol, yields orcin when fused with caustic potassa, although it might have been supposed that a diphenol of the formula—

$$C_7H_6\begin{Bmatrix}OH\\OH\end{Bmatrix}$$

This reaction is elucidated by the following formula:—

$$*\ C_7H_6\begin{Bmatrix}Cl\\SO_3K\end{Bmatrix}+2KHO=C_7H_6\begin{Bmatrix}OH\\OH\end{Bmatrix}+KCl+SO\begin{Bmatrix}OK\\OK\end{Bmatrix}$$

The orcin thus synthetically formed is in all respects identical with that obtained from lichens, but the process of preparing it is not industrially applicable.

Researches on the Physiological Action of the Different Opium Alkaloids.—Dr. Rabuteau.—This lengthy memoir contains the results of some very important experiments, made with the view to elucidate the action of the different opium alkaloids upon the human system.

This number also contains a series of important papers relating to astronomy, meteorology, geology, and zoology.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 7, 1872.

This number contains the following original papers and memoirs:—

Specific Heat of Carbon.—H. F. Weber.—Notwithstanding the high scientific value of this exhaustive memoir, its contents are not well suited for abstraction.

* This salt is formed from the baryta salt by double decomposition with sulphate of potassa.

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Behaviour of the so-called Sulphuric Acid Chamber Crystals towards Water.—C. Rammelsberg.—In the introduction to this lengthy memoir, the author first reviews the conditions of the formation of the compound alluded to, which may be formed (1) by the action of sulphuric acid upon nitrous acid; (2) by the action of sulphuric acid on dioxide of nitrogen (so-called hyponitric acid); (3) by the action of sulphurous acid upon dioxide of nitrogen in the presence of too small a quantity of water. This latter is the mode of formation in the sulphuric acid chambers if sufficient water (steam) is not present. The author then quotes the results of the analysis of the crystals as found by Clément and Desormes, Gaultier de Claubry, Weber, Weltzien, and others. The formula of the lead chamber crystals is—

$$\left\{\begin{matrix} H_2 \\ SO_3 \end{matrix}\right\} O_3 \quad \left\{\begin{matrix} N_2O_2 \\ SO_3 \end{matrix}\right\} O_3$$

In the continuation of this memoir, the author treats at great length on the action of water upon the body just alluded to; it appears that in 100 parts of the crystals there are contained 6·38 per cent of N_2O_3 = N, 1·65, and 20·47 per cent N_2O_3 = N, 7·54; N = 9·19 per cent; to this quantity of N has to be added 2·57 N which are set free in the shape of NO, bringing the total amount of N up to 11·76 per cent. By becoming decomposed by water, the chamber crystals yield 22 per cent of oxide of nitrogen, 14 per cent of nitric acid, and 64 per cent of nitrous acid.

Estimation of Uric Acid.—H. Schwanert.—The main gist of this physiologico-chemical paper is that hydrochloric acid fails to precipitate uric acid from urine completely, so that, upon 100 c.c. of fluid (urine) treated with hydrochloric acid, a quantity of 0·0048 grm. of uric acid remains in solution, and has, of course, to be added to the quantity of uric acid found.

Short Communication on Naphthalin-Carboxyl-Acid-Amide.—P. v. Rakowski.—The author states that, while preparing naphtoë acid according to Merz's method, by boiling naphthalin-cyan with alcoholic potassa solution, he obtained, by exhausting the residue with water, a compound (not naphthalin, as stated by Merz) which, on being submitted to elementary analysis, led to the formula $C_{11}H_9NO$ —that is to say, naphthalin-carboxyl-acid-amide; constitutional formula, $C_{10}H_7CONH_2$.

Silico-Heptyl Series.—A. Ladenburg.—The continuation of a lengthy monograph on this subject.

Constitution of Benzol.—A. Ladenburg.—The contents of this paper are, notwithstanding the intrinsic merits, not well suited for useful abstraction.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 232, April, 1872.

This number does not contain any original papers relating to chemistry.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, March 14, 1872.

Alloy which may serve to Unite Iron or Steel to Brass.—C. Méne.—The alloy consists of 3 parts of tin, 39·5 of copper, and 7·5 of zinc, which latter, since some of it is volatilised by the smelting together of the metals, may be increased to 10 parts; this alloy may serve to unite (solder together) copper or brass to iron or steel.

Les Mondes, April 25, 1872.

Bibliography.—Under this heading we quote the titles of the following works, which are highly spoken of in the above-quoted periodical:—"Histoire de l'Economie Politique des Anciens Peuples de l'Inde, de l'Egypte, de la Judée, et de la Grèce," par M. du Mesnil-Marigny; 2 vols.; Paris: H. Plon, 1872. "Cours Elémentaire de Géologie Appliquée, Lithologie Pratique ou Etude Générale et Particulière des Roches," par M. Stanislas Meunier; Paris: Dunod, 1872.

General Theory of Chemical Action.—Dr. E. J. Maumené.—The first instalment of a series of papers on this subject, elucidated by woodcuts and a series of algebraical formulæ.

Annalen der Chemie und Pharmacie, May, 1872.

This number contains the following original memoirs and papers:—

Butyric Acids of various Origin.—C. Grünsweig.—This very lengthy monograph contains the following sections:—Introduction, a concisely written and complete review of all that has been done by different authors in this direction; normal butyric acid; oxidation of normal butyric acid; salts of the normal butyric acid, viz., of silver, calcium, strontium, and zinc; normal butyric acid isobutylester (*Isobutylester*); isobutyric acid; oxidation of isobutyric acid; salts of this acid, viz., of silver, calcium, strontium, and zinc; isobutyric acid isobutylester; butyric acid from butter; butyric acid from coniine; butyric acid from St. John's bread, carob-tree (*Ceratonia siliqua*).

Pollen, and on the Formation of Wax.—W. von Schneider.—The first instalment of an exhaustive monograph, the contents of which are, notwithstanding their high scientific value, not suited for abstraction.

Studies on the Combinations of the Camphor Group.—J. Kachler.—The second instalment of a lengthy monograph on this subject divided into the following sections:—Campholic acid, $C_{10}H_{18}O_2$; salts of this acid, viz., of potassa, soda, ammonia, lime, baryta, magnesia, zinc, copper, silver; campholic acid and bromine; campholic acid and phosphorchloride; dry distillation of the salts of campholic acid; campinic acid.

Azo Compounds of Resorcine.—P. Weselsky.—This memoir, elucidated by a large number of complex and lengthy formulæ, is divided into the following chapters:—Introduction; diazo-resorufin; hydrochlorate of hydro-diazo-resorufin; resorcin-tetra-azo compounds; nitrate of tetra-azo-resorufin; nitrate of dihydro-tetra-azo-resorcin; hydrochlorate of hydro-amido-tetra-azo-resorufin; hydro-imido-tetra-azo-resorufin; diazo-resorcin and acetyl-chloride.

On Dextronic Acid.—J. Habermann.—The acid just named is formed from dextrine, in the same manner as lactonic acid is formed from sugar of milk, viz., by heating in a water-bath a mixture of 50 grms. of dextrine, 300 c.c., and 40 grms. of bromine, the mixture being poured into strongly-made bottles,—champagne wine bottles answer the purpose best,—the fluid is first treated with oxide of silver, next with hydro-sulphuric acid, and the free dextronic acid then converted into a lime, and afterwards into a lead salt, from which at last the acid is set free; the free acid is very similar to gluconic acid, but exhibits a slight difference from the latter as regards its behaviour in the polarisation apparatus; dextronate of lime, $C_6H_{11}CaO_7 + \frac{1}{2}H_2O$, contains water of crystallisation driven off at 120°.

Products of Distillation of Sugar mixed with Lime.—R. Benedikt.—This paper treats on the substances obtained by the dry distillation of a mixture of lime and sugar (3 parts of lime to 1 of sugar). The author states that metaceton and isophoron are the chief fluid products of this operation, but a large quantity of gases are simultaneously formed.

Some of the Products of the Condensation of Aldehyde.—A. Kekulé.—The fourth portion of this monograph, treating on the condensation of aldehyde with the taking up (*Aufnahme*) of hydrogen.

On Rufiopine.—C. Liebermann and C. Chojnacki.—After first referring at some length to the researches of Anderson, Matthiessen, Foster, and others on this subject, the authors treat on the preparation of rufiopine, a colouring matter, $C_{14}H_8O_4$, which they state to be very closely allied to the madder pigments; while, moreover, rufiopine, treated with zinc dust, yields anthracen. The close alliance between rufiopine and the anthracen pigments is elucidated in the following manner:—$C_{14}H_8O_2$, monoxy-anthrachinon; $C_{14}H_8O_3$, alizarine; $C_{14}H_8O_3$, purpurine; $C_{14}H_8O_6$, rufiopine (pseudopurpurine?); $C_{14}H_8O_8$, rufigallic acid.

On Naphthazarine.—C. Liebermann.—Notwithstanding the high scientific value of this memoir, its contents are not well suited for any useful abstraction, an observation also bearing upon the following memoir:—

Aromatic Glycolic Acid.—W. Dittmar and A. Kekulé.

Some Combinations of Tungsten (Wolfram).—Dr. H. E. Roscoe.—This essay is divided into the following sections:—Preparation of metallic tungsten; chlorides of tungsten—viz., hexachloride, pentachloride, tetrachloride, dichloride; oxychlorides; bromides; reduction of the pentabromide in hydrogen; oxybromides—viz., monoxybromide, dioxybromide; iodide; atomic weight of tungsten—(*a*) by reduction of the trioxide, (*b*) by analysis of the hexachloride.

Salt (Chloride of Sodium) contained in the Extract of Meat.—Dr. J. Baron von Liebig.—The eminent *savant* has written this paper with the view to refute the allegation made by a Dr. Godefroy, who appears to have published, in an Austrian scientific paper, a statement to the effect that Liebig's extract of meat should contain 2 per cent of chloride of sodium, purposely added as a fraud. The author refers Dr. G. to his (Liebig's) essays published in this periodical some twenty years ago, "On the Constituents of the Fluids contained in Meat," and emphatically denies that at Fra Bentos, where the extract of meat is made, any common salt is added to it. Chloride of potassium is largely contained in the extract.

Oxygen-Containing Ethyl Compounds.—E. Erlenmeyer.—This essay is divided into the following chapters:—Experiments on the formation of alcohol from ether, and of ether from alcohol, under the influence of dilute sulphuric acid and a higher temperature; formation of ether from alcohol under the influence of sulphuric acid, ethyl-ester (*äthylester*) and ethyl-sulphuric acid; sulphuric acid ethyleester; alcohol and ethyl-sulphuric acid; on Gerhardt's parathionic acid.

Dicyanacetic Acid.—D. Amato.—This paper treats at length on the results of a series of experiments made with the view of trying to bind three carboxyles (CO.OH) to the same carbon atom. The author describes, however, mainly the action of cyanide of potassium upon dichloracetic ether.

La Revue Scientifique de la France et de l'Etranger, April 27, 1872.

This number does not contain any original papers on chemistry, but we quote the titles of the following interesting papers:—

The Resources, Soil, Climate, Population, Agriculture, Industry, and Commerce of the Alsace.—Ch. Grad.

Continuation of the Lectures on Animal Heat; Temperature of Arterial and Venous Blood.—C. Bernard.—Illustrated by woodcuts.

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NOTES AND QUERIES.

Waste of Sulphur in the Cornish Tin Mines.—The writers of letters to Dr. Tayler with reference to the article as above, which appeared in last week's number, will oblige by sending their addresses, as their letters have been lost in forwarding to the post.—W. H. Tayler, M.D., Tudor House, Anerley, Surrey.

Chinese Cement.—Some time since there appeared a notice of a Chinese Cement (Schio Liao), consisting of 3 parts of blood and 4 of lime, with a little alum. I have tried it, but not with the success I expected. I have used sheep's blood. Finding in Cooley's "Receipts" what is called "coppersmith's cement," made from bullock's blood and lime, I shall be glad if any of your readers can suggest any difference between the two which would be likely to alter the cement.—C. E.

MEETINGS FOR THE WEEK.

Monday, June 3rd.—Royal Institution, 3. General Monthly Meeting.
—— London Institution, 4. Prof. Bentley, F.L.S., "On Elementary Botany."
Tuesday, 4th.—Royal Institution, 3. E. B. Tylor, F.R.S., "On the Development of Belief and Custom amongst the Lower Races of Mankind."
—— Zoological, 9.
Wednesday, 5th.—Microscopical, 8.
—— Geological, 8.
Thursday, 6th.—Royal Society Club, 6.
—— Royal Institution, 3. Prof. Tyndall, LL.D., F.R.S., "On Heat and Light."
Friday, 7th.—Royal Institution, 9. Dr. Odling, F.R.S., "On the History of Ozone."
—— Geologists' Association, 8.
Saturday, 8th.—Royal Institution, 3. Prof. Roscoe, F.R.S., "On the Chemical Action of Light."

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THE CHEMICAL NEWS.

Vol. XXV. No. 654.

ON A DOUBLE SULPHIDE OF GOLD AND SILVER.*

By M. M. PATTISON MUIR, F.C.S.

About eight months ago, at the Thames Goldfield, New Zealand, my brother, Mr. John M. Muir, in conjunction with Mr. William Carrick, made some experiments upon the action of sulphur on a molten mixture of gold and silver, with the view of applying the reaction to the separation of these metals on the large scale. These experiments resulted, however, somewhat otherwise from what they had expected; instead of a complete separation of gold and silver being effected by means of the formation of a sulphide of silver, they found what seemed a new compound produced. A sample of this substance they sent to me, an analysis of which I hope will not prove wholly uninteresting.

Before proceeding to the actual analysis of the substance, I shall briefly state the general method employed by my brother and Mr. Carrick when studying the action of sulphur on gold and silver. The crude gold containing silver was placed in a large pot upon the furnace, where it stood until the contents were molten. Into an iron mercury-bottle turned upside down, by means of a screw-tap, was poured a quantity of sulphur; fitted to the other, that is, the downward end of the bottle, was a plumbago pipe. The sulphur in the bottle, by means of a furnace-fire, was now rendered liquid, and the bottle swung over the pot containing the molten gold and silver. The lower end of the plumbago pipe having been inserted beneath the surface of the molten mixture, the sulphur was allowed to flow down the pipe, and bubble through the contents of the pot. Before doing this, however, a thin film of borax was spread over the molten gold and silver. Quantities of Thames gold, varying from 20 ozs. to 160 ozs., were then treated, the operation being continued from ten minutes to an hour.

At the end of this treatment with sulphur, the pot was taken off the fire, and the gold allowed to solidify, the liquid borax and what they supposed to be sulphide of silver being then poured off. The borax was easily broken off after cooling, and the sulphide obtained as a cake. It was invariably, in all the experiments which my brother and Mr. Carrick conducted, found that the assay of the gold rose from 654 to 812, but there remained stationary, showing that by no means all the silver was extracted. The substance which they supposed to be a double sulphide of gold and silver,—and this supposition, has, I think, been confirmed by analysis,—is a dark grey, hard solid, very much resembling many specimens of native Sb sulphide. It has a crystalline structure, can be cut by a knife, but is very brittle, and has a specific gravity of 8·159. By heating in a current of air, it remains undecomposed. But, by fusion with Na_2CO_3, a sulphide of Na is formed, and a second alloy of gold and silver remain. After protracted boiling in strong HNO_3, almost all the silver is dissolved, leaving nearly pure metallic gold. I found that by gentle heating with strong H_2SO_4 for a long time, and subsequent treatment with hot water, it is possible to obtain all the silver in solution, the gold being left behind as a finely divided powder.

1·1915 grms. thus treated gave 0·4252 grms. of gold = 35·569 per cent. The filtrate, precipitated with HCl, gave 0·7799 grms. AgCl = 0·5870 Ag = 49·27 per cent. Another portion, weighing 0·5475 grm., heated gently with strong HCl and $HClO_3$, gave in the solution a precipitate of $BaSO_4 = 0·6414 = S$, 0·0885 = 16·17 per cent.

From the results of my analysis, I have deduced the formula for the substance of $2(Au_2S_3)5(Ag_2S)$.

The percentage amounts required by this formula, together with those actually obtained, are given below:—

	Calculated.	Found.
Sulphur	15·87	16·17
Gold	35·47	35·69
Silver	48·66	49·27
	100·00	101·13

* Read before the Glasgow Philosophical Society, April 29, 1872.

ANALYSIS OF SOME CRYSTALS DEPOSITED UPON THE ZINC OF A LECLANCHE BATTERY.

By GEORGE E. DAVIS.

In the month of July, 1871, I put up an electric bell at my residence, which was worked by two cells of a Leclanché battery. These cells were of the Bunsen form,—zinc cylinders, with a carbon block in a porous pot. The carbon block was packed into the porous pot, with a mixture of pounded gas-carbon and manganese dioxide, to within half an inch of the top, and the pot was then filled to the top with melted resin, to which bees'-wax had been added to prevent cracking. All the dust was carefully sifted from the carbon-manganese mixture, that used resembling a very coarse gunpowder, and the solution used was a saturated one of ammonium chloride. At the end of February, 1872, the battery began to exhibit signs of exhaustion, and ultimately, early in March, refused to act altogether, except when the circuit was kept closed for a long period of seconds. I may as well add that evaporation was compensated for by the periodical addition of distilled water, nothing else being added to the battery.

On taking the battery to pieces, for the purpose of cleaning it, the porous pot was found to be encrusted with a white insoluble powder: the zinc cylinder was also encrusted, but to a less extent, and from it grew seven or eight opaque white crystals, of the second system,—perfect octahedrons having square bases: they were washed with distilled water, and dried over sulphuric acid.

A qualitative analysis showed me zinc oxide, chlorine, and ammonia, so the quantitative was an easy operation. Only the zinc oxide and the chlorine were determined, as they were deemed sufficient to elucidate the composition of the crystals.

α. 0·91 grm. of the crystals gave 0·48 grm. of ZnO, or 52·74 per cent.

β. 0·7 grm. of the crystals gave 0·37 grm. of ZnO, or 52·85 per cent.

γ. 0·58 grm. gave 0·55 grm. of AgCl, or 23·44 per cent of chlorine.

These numbers obtained agree closely with the formula $ZnH_2O_2NH_4Cl$, thus:—

	Calculated.		Found.	
ZnO	81·0	53·11	52·74	52·85
H_2O	18·0	23·62	—	—
NH_4	18·0		—	—
Cl	35·5	23·27	23·44	—
	152·5	100·00		

Cold water dissolved but little of the ammonium chloride out of the powdered crystals, but when *boiled* with a large quantity of water the salt is decomposed, ammonium chloride dissolving, and leaving behind the zinc hydrate.

Radcliffe, May 29, 1872.

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ON THE LAST NEW METAL, INDIUM.*

By WILLIAM ODLING, M.B., F.R.S.,
Fullerian Professor of Chemistry, R.I.

(Concluded from page 254).

THE chief point of chemical interest with regard to any newly-discovered element, and consequently with regard to indium, is the establishment of its atomic weight, which, in the case of a metallic element, is based primarily upon the determination of the ratio in which it combines with oxygen and chlorine. Now the quantity of indium which unites with 8 parts by weight of oxygen and with 35·5 parts by weight of chlorine, has been found by Winkler to be 37·9, and by Bunsen to be 37·8 parts. But this determination of combining ratio falls far short of the definite establishment of the atomic weight of the metal. For example, the quantities of silver, mercury, bismuth, tin, and tantalum, which exist in the best-known chlorides of these metals combined with 35·5 parts of chlorine, are 108, 100, 70, 29, and 37 parts respectively. Nevertheless, the atomic weights of these metals are taken to be not 108, 100, 70, 29, and 37, but 108, 200, 210, 118, and 184 respectively, the chlorides of the several metals being expressed by the formulæ $AgCl_1$, $HgCl_2$, $BiCl_3$, $SnCl_4$, and $TaCl_5$, respectively. Accordingly, in order to deduce the atomic weight of indium from the ascertained composition of its chloride, we require first to know whether its chloride is a mono-, di-, tri-, tetra-, or penta-chloride. Now, in the case of a metal forming only one definite chloride, the constitution of the chloride as a mono- or poly-chloride, may frequently be determinated by a consideration of the analogies presented by the metal and its compounds to some other metal and its compounds, of which the atomic weight and molecular formulæ respectively are well established. But it is obvious that analogy can afford but little help in the case of a newly-discovered element, of which the analogies have still to be determined.

Failing analogy, a more sure guide to the establishment of the molecular formula of a metallic chloride is afforded in some instances by a determination of its vapour density, —tantamount to a determination of the quantity of chlorine by weight, contained in a given volume of the gas or vapour of the chloride experimented on. Thus, having estimated the quantity of chlorine contained in a given volume of heated muriatic acid gas, the quantities of chlorine contained in the same volume of the vapourised chlorides of mercury, bismuth, tin, and tantalum, under the same circumstances of pressure and temperature, are found to be 2, 3, 4, and 5 times as great, whence the formulæ HCl_1, $HgCl_2$, $BiCl_3$, $SnCl_4$, and $TaCl_5$, respectively. Now indium chloride being volatile at a red heat, there is no reason, save that resulting from the rarity and value of the body, why the density of its vapour should not be ascertained. As a matter of fact, however, no estimation of the vapour density of indium chloride has yet been made, and any evidence that might be deducible from it is consequently not forthcoming.

Lastly, a most important guide to the establishment of the atomic weight of a metal is the determination of its specific heat. In cooling through the same fall of temperature, different bodies, as is well known, give out exceedingly different quantities of heat. In the case of a pound of bismuth and a pound of brass, for instance, both raised to the temperature of boiling water, and then immersed in an excess of ice, the quantity of ice melted by the pound of brass in cooling down to the freezing-point, will be found to be more than three times as great as the quantity of ice melted by the pound of bismuth. Now the determination of the specific heats of most of the metals, compared with the specific heat of an equal weight of water as unity, has been made with extreme care and exactitude by Regnault; and on looking at the following list of specific heats, mostly of his determination, it is evident, almost at a glance, that the specific heats of the metallic elements are inversely as their respective atomic weights. Thus, taking the first and last elements on the list for example, it is observable that the specific heat of lithium, or 0·94, is weight for weight thirty times greater than the specific heat of bismuth, 0·03; but then the atomic weight of bismuth is thirty times greater than that of lithium. And throughout, the product of the specific heat into the atomic weight of one metal, divided by the product of the specific heat into the atomic weight of another metal, is approximatively equal to 1, as shown in the fourth column of the following table, in which the product of the specific heat into the atomic weight of silver is taken as the standard dividend. Now, only last year, concordant estimations of the specific heat of indium were made by Bunsen and a Russian chemist, Mendelejeff; the mean of Bunsen's two estimations being 0·0569, which, it will be observed, is very close to Regnault's estimations of the specific heats of silver, cadmium, and tin. Accordingly, the atomic weight of indium must approximate to the atomic weights of silver, cadmium, and tin; or, in other words, it cannot be 37·8×1, or 37·8×2, but must be 37·8×3=113·5; and the quantity of chlorine combined with this weight of indium being three times 35·5 parts, indium chloride will necessarily appear as a trichloride, and be expressed by the formula $InCl_3$. The determination of specific heats being a matter of direct experiment, with scarcely any ratiocination whatever, it seems impossible for anyone to observe the relationship subsisting between the accepted atomic weights of the metals, deduced from experiment by a highly complex train of reasoning, and their directly ascertained specific heats, without recognising that in the case of the metals, at any rate, the atomic weights of the chemist are something more than vain imaginings, but that they are beyond question the terse expression of a fundamental truth in nature.

TABLE II.—ATOMIC HEATS OF METALS.

Chlorides.	Atomic Weights.	Metals.	Specific Heats.	Atomic Heats.
LiCl	7	Lithium ..	0·9408	1·07
NaCl	23	Sodium ..	0·2934	1·09
$MgCl_2$.. ..	24	Magnesium..	0·2499	0·97
$AlCl_3$	27·5	Aluminum ..	0·2143	0·95
KCl	39	Potassium ..	0·1695	1·07
$CaCl_2$	40	Calcium ..	0·1686	1·09
$MnCl_2$.. ..	55	Manganese ..	0·1217	1·08
$FeCl_2$, $FeCl_3$	56	Iron	0·1138	1·03
$NiCl_2$	59	Nickel	0·1075	1·03
$CoCl_2$	59	Cobalt.. ..	0·1067	1·02
CuCl, $CuCl_2$	63·5	Copper ..	0·0955	0·98
$ZnCl_2$	65	Zinc	0·0955	1·01
$AsCl_3$	75	Arsenic ..	0·0814	0·99
$MoCl_4$.. ..	96	Molybdenum.	0·0722	1·12
$RuCl_3$, $RuCl_4$	104	Ruthenium ..	0·0611	1·03
$RoCl_3$	104	Rhodium ..	0·0580	0·98
$PdCl_2$	106	Palladium ..	0·0593	1·02
AgCl	108	Silver	0·0570	1·00
$CdCl_2$	112	Cadmium ..	0·0567	1·03
$InCl_3$	113·5	Indium ..	0·0569	1·05
$SnCl_2$, $SnCl_4$	118	Tin	0·0562	1·07
$SbCl_3$, $SbCl_5$	122	Antimony ..	0·0508	1·00
$TeCl_4$	129	Tellurium ..	0·0474	1·03
WCl_4, WCl_6	184	Tungsten ..	0·0334	1·00
AuCl, $AuCl_3$	196·5	Gold	0·0325	1·03
$IrCl_3$, $IrCl_4$	197	Iridium ..	0·0326	1·04
$PtCl_2$, $PtCl_4$	197	Platinum ..	0·0324	1·04
$OsCl_2$, $OsCl_4$	199	Osmium ..	0·0311	1·00
HgCl, $HgCl_2$	200	Mercury ..	0·0319	1·03
TlCl, $TlCl_3$	203	Thallium ..	0·0325	1·07
$PbCl_2$	207	Lead	0·0314	1·05
$BiCl_3$	210	Bismuth ..	0·0308	1·05

* Read before the Royal Institution of Great Britain.

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Table III.—Elements, in Order of Atomic Weight.*

	1.	2.	3.	4.	5.	6.	7.	8.	Type.
I.	H 1	Li 7	Na 23	K 39	..	Rb 85	Ag 108	Cs 133	RCl
II.		G 9	Mg 24	Ca 40	Zn 65	Sr 87·5	Cd 112	Ba 137	RCl_2
III.		B 11	Al 27·5	..	..	*Xa*	In 113	*Xb*	RCl_3
IV.		C 12	Si 28	Ti 50	..	*Zr* 89	Sn 118	*Xc*	RCl_4
V.		N 14	P 31	V 51	As 75	Nb 94	Sb 122	..	RCl_5
VI.		O 16	S 32	Cr 52·5	Se 79	Mo 96	Te 129	..	RCl_6
VII.		F 19	Cl 35·5	Mn 55	Br 80	..	I 127	..	RCl_7
VIII.		..	..	Fe 56 } Co 59 } Ni 59 }	..	Ru 104 } Ro 104 } Pd 106 }	..	..	RCl_8
		Na 23	..	Cu 63·5	..	*Ag* 108			

The most important chemical characters of indium being thus established, there remains for consideration only the question of its affinities to certain of the previously-known elements. And seeing that the atomic weights of the elements range from 1, the atomic weight of hydrogen, up to 240, the atomic weight of uranium, there opens out the further question, whether the more obvious chemical properties of the different elements are seriated in any way with their atomic weights; or to put this last question in another form, whether the varied chemical properties of the elements are distributed among them haphazard, or according to some definite system of which the relationship subsisting between their several atomic weights may possibly serve as a key. Now the atomic weights, as distinguished from the combining proportions, of yttrium, erbium, cerium, lanthanum, and didymium, must be regarded for the present as quite unknown. Out of the fifty-eight elements, however, of which the atomic weights have been more or less well-determined, forty-six have their several atomic weights ranging from 1 to 137, in an almost unbroken succession. Ten of the other twelve have atomic weights ranging from 184, that of tantalum, to 210, that of bismuth; while the remaining two, namely, thorium and uranium, have the closely-approximating atomic weights 238 and 240 respectively. In the above Table, the symbols of the forty-six elements having atomic weights ranging from 1 to 137, are set down in the order of the atomic weights of the elements symbolised,—save only in the case of tellurium, of which the symbol is placed immediately above, instead of below, that of iodine, and of which the atomic weight may not improbably have been somewhat over-estimated. And violating the order of numerical seriation in this small particular only, it is remarkable with what facility the symbols of the forty-six elements may be arranged in parallel lines and columns, corresponding to a natural classification of the elements themselves into analogous groups and series. Indeed, a study of the entire number of elements at present known would seem to indicate that they are one and all associated with each other by a certain community of relationship; of which the well-known gradation and parallelism in properties and atomic weights, of the members of the alkali and earth-alkali, and of the halogen and oxygen families of elements, afford only the most prominent examples.

Taking the second line of the Table as an illustration, it is observable that the seven metals symbolised thereon are distinguished from all the others by their common property of forming one chloride only, and that a di-chloride; further, that the metals figuring in the uneven-numbered columns of this line, namely, magnesium 24, zinc 65, and cadmium 112, are permanent in the air, are volatilisable in the direct and basylous in the inverse order of their atomic weights, and are otherwise specially associated with one another; while the similarly associated metals of the alternate or even-numbered columns, namely, calcium 40, strontium 87·5, and barium 137, are quickly oxidisable in the air, are practically non-volatile, and are basylous in the direct instead of the inverse order of their atomic weights; and similarly, on the other lines of the Table, the elements symbolised are divisible into sub-groups, according to their odd and even positions respectively.

Such being the relationship of the elements placed on the same line, the relationship of those in the same column is of a different kind. Taking the third and seventh columns by way of illustration, it is observable that the consecutive elements in each column have closely consecutive atomic numbers; that the element on the first line forms a mono-chloride; that on the second line, a di-chloride; that on the third line, a tri-chloride; and that on the fourth line, a tetra-chloride; while those on the fifth, sixth, and seventh lines form oxides or oxychlorides, corresponding to a penta-, hexa-, and hepta-chloride respectively.

By reason of its atomic weight, 113·5, indium is observed to figure on the third line and seventh column of the above Table; but its position among the elements is better recognisable by a glance at the Table below, containing a portion only of the preceding one, supplemented by an additional column of elements of higher atomic weight than any of those included previously.

In respect of its atomic weight, then, triad indium occupies a position exactly intermediate between the positions of diad cadmium and tetrad tin, to both of which metals it presents a most marked resemblance in properties. They all three have the same extreme degree of fusibility, and much the same oxidisability and reducibility. Their sulphides are alike characterised by a yellow colour, that of cadmium, CdS, being neutral; that of tin, SnS_2, being acidulous; and that of indium, In_2S_3, being strictly intermediate.

	3.	7.	10.	Type.
I.	Na 23	Ag 108	—	RCl
II.	Mg 24	Cd 112	Hg 200	RCl_2
III.	Al 27·5	In 113·5	Tl 203	RCl_3
IV.	Si 28	Sn 118	Pb 207	RCl_4
V.	P 31	Sb 122	Bi 210	RCl_5
VI.	S 32	Te 129	—	RCl_6

Viewed in another aspect, triad indium occupies a position intermediate between the positions of its remote triad congeners, aluminium and thallium. The mean atomic weight of the three metals being 114·3, the atomic weight of indium is 113·5. The mean specific gravity of the three metals being 7·3, the specific gravity of indium is 7·4. And in respect of purely chemical habitudes, hydrated alumina and hydrated india might easily be mistaken for one another. It is interesting, moreover, to remark that the last-discovered two metals indium and thallium—discovered, it will be remembered, by the same process, that of spectrum analysis—should bear to one another much the same sort of relation that is borne to one another by the jovian and saturnine metals of the alchemical or even pre-alchemical era. Just, for example, as the unstable and least-known chloride of lead, $PbCl_4$, corresponds to the stable chloride of tin, $SnCl_4$, so does the unstable and least-known chloride of thallium, $TlCl_3$, correspond to the stable, and as yet only known, chloride of indium, $InCl_3$, as suggested, indeed, by the lecturer some six or seven years ago.

The study of such relationships necessarily suggests many inquiries. Arranging the entire fifty-eight elements of which the atomic weights are known, in a table similar to the preceding one for the forty-six elements having atomic weights not exceeding 137, some twenty or five-and-twenty new elements would be required to fill up the gaps in the different series; but why should not new elements be discovered having atomic weights as much above that of uranium, 240, as its atomic weight is above that of barium, 137?

Again, does it seem probable that bodies capable of being arranged in such a well-marked numerical series, are really elementary and mutually independent; or is it more likely that the gradation of properties and atomic

* This Table is based on one published by the author in 1864-5. Similar tables have been constructed by Newlands, Meyer, Mendelejeff, and others. The positions marked *Xa*, *Xb*, and *Xc*, are assigned by Mendelejeff to yttrium, didymium, and cerium, respectively. The assumption of the atomic weight of uranium as 240, is also due to Mendelejeff.

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numbers manifested by these bodies, depends on their possession of different increments of common material?

May it not be that the numerical ratio between the atomic numbers of proximate elements, $\frac{x}{y}$ = approximatively $\frac{y}{z}$, is really absolute; and that it will hereafter be proved to be so by a better determination of atomic weights. Seeing that a short time back, cæsium with the atomic weight 133, and rubidium with the atomic weight 85, both occurred as unrecognised impurities in potassium with its atomic weight 39, who shall answer for the absolute accuracy of even the best established of our present atomic weights?

Again, the mean difference in atomic weight between consecutive analogous elements is, in the case of the nine following pairs of elements, lithium and sodium, glucinum and magnesium, boron and aluminum, carbon and silicon, nitrogen and phosphorus, oxygen and sulphur, fluorine and chlorine, sodium and potassium, magnesium and calcium, 16·1; the lowest difference being 15, and the highest 17. The mean difference in the case of the four following similar pairs of proximate elements, phosphorus and vanadium, sulphur and chromium, chlorine and manganese, arsenic and niobium, is 19·25; the lowest difference being 19, and the highest 20·5. Lastly, the mean difference in the case of the seven following similar pairs of proximate elements, calcium and zinc, vanadium and arsenic, manganese and bromine, rubidium and silver, strontium and cadmium, silver and cæsium, tantalum and bismuth, is 24·6; the lowest and highest differences, even in the case of these elements of such high atomic weight, being 23 and 26 respectively. Are these differences in atomic weight only approximatively, or are they indeed absolutely, 16, 20, and 24 respectively; and if so, why should the numerical difference between proximate associated elements be 16 in one set of cases, 20 in another set, and 24 in a third?

ON THE

PART WHICH FERRIC AND ALUMINIC OXIDES PLAY IN THE MANUFACTURE OF SUPERPHOSPHATE;

AND ON THE

COMPARATIVE VALUE OF MINERAL PHOSPHATES.*

By T. L. PATTERSON, F.C.S.

(Concluded from p. 257.)

The Comparative Value of Mineral Phosphates.

Continuing to speak of these from a decomposition point of view, and assuming that the tricalcic phosphate is the only valuable ingredient they contain, it will be necessary to consider how far their value is modified by the presence of ferric and aluminic oxide, which, I have just shown, reduce or render insoluble a portion of the phosphoric acid.

It is well known that superphosphate of lime, when applied to the soil, soon has its phosphoric acid precipitated as insoluble tricalcic phosphate, by means of the earthy carbonates contained therein. And it is admitted by all chemists that such precipitated tricalcic phosphate possesses with soluble phosphate of lime, the same value as a fertiliser. It is also admitted by chemists that the great value of soluble or precipitated tricalcic phosphate, compared with mineral phosphates, depends wholly on the much greater solubility of the former. By determining, then, the solubility of ferric and aluminic phosphates, we will be in a position to form more correct notions as to their manurial value. I therefore made two other experiments to clear up this point.

Expt. 10.—Carbonic acid gas was continuously passed through distilled water holding pure precipitated tricalcic phosphate (thoroughly washed and dried in the water-bath) in suspension for five hours, when the undissolved portion was removed by filtration. On heating a portion of the filtrate to boiling with nitric acid and ammonia molybdate, a considerable yellow precipitate was obtained. To another portion of the filtrate was added one drop of a solution of ferric alum, when a slight precipitate was immediately produced. After standing some time, it collected at the bottom of the vessel. The phosphate of lime solution was now added in excess, and the ferric phosphate filtered off. The filtrate gave no blue colour with ferrocyanide, and only a faint reddish tinge with sulphocyanide of potassium, when acidified with HCl. To a third portion of the filtrate ferric alum was added in excess, when the precipitate at first formed re-dissolved. To a fourth portion of the filtrate a drop of aluminic alum was added. An opalescence was immediately produced, and after standing some time, a precipitate of aluminic phosphate separated. When the alum solution was added in excess, the precipitate was re-dissolved. On separating the aluminic phosphate precipitate,—after a carefully conducted precipitation to insure the merest trace of alum in excess,—a drop of the ferric alum produced in the filtrate a second precipitate of ferric phosphate; thus showing aluminic phosphate to be the more soluble of the two.

Expt. 11.—Very finely ground and washed coprolite, suspended in distilled water, was subjected to a continuous stream of CO_2, as was the pure tricalcic phosphate in Experiment 10. The undissolved portion was then filtered off, and the filtrate, when tested with molybdic acid solution, only gave a slight trace of a yellow precipitate. On evaporating the filtrate to one-fourth, however, good evidence of the presence of phosphoric acid was obtained. Aluminic alum produced in the filtrate a barely perceptible opalescence, which, after standing some time, collected as a precipitate at the bottom of the vessel. This precipitate was removed by filtration, and tested with molybdic acid, after solution in dilute nitric acid. A considerable yellow precipitate proved the presence of phosphoric acid. The filtrate evaporated to one-fourth only gave a trace of a yellow precipitate with molybdenum solution. To another portion of the coprolite solution I added a drop of ferric alum; an opalescence was immediately produced. With a slight excess of the precipitant, the precipitate has a yellow colour, caused by the calcic carbonate in solution throwing down hydrated ferric oxide; and when the precipitant is in great excess, no precipitate at all is formed, or that at first formed is re-dissolved. (This is also the case with an excess of aluminic alum). On removing the yellow precipitate thus formed, and dissolving it in dilute nitric acid, abundant evidence of the presence of phosphoric acid was obtained, on heating the solution with molybdic acid to boiling. The filtrate, when evaporated to one-fourth, gave the merest trace of a yellow precipitate when tested with molybdic acid.

The results of these experiments are similar to some made by Warington † with another object in view. I thought this precipitation method of experimenting preferable to dissolving separate portions of each in carbonic acid, and determining the amount dissolved, as it produces a minute quantity of these phosphates in the very best possible condition for solution; and, as it has turned out, shows at a glance how insoluble they are compared with ground coprolite and pure tricalcic phosphate. If we arrange them in the order of their solubilities, coprolite will come first, aluminic phosphate next, and ferric phosphate last. I forget the actual solubility of coprolite, and cannot remember where I have seen it stated. Bischof-

* Read before the Chemical Section of the Glasgow Philosophical Society, April 29th, 1872.

* Chemical News, vol. xvi., p. 253, and vol. xxi., p. 221.

† "Chemical and Physical Geology," vol. ii., p. 34.

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gives the solubility of wavellite as one part in 6,828,000 parts of carbonic water; but it is likely the precipitated aluminic phosphate here referred to is much more soluble than that. And ferric phosphate must be very slightly soluble indeed, when we consider the extreme delicacy of the sulphocyanide test for iron, and the molybdate of ammonia test for phosphoric acid, and that only minute traces of these bodies were found in the filtrate from the ferric phosphate precipitate.

Now, most agricultural authorities are agreed that ground coprolite in a superphosphate is worthless. Voelcker says,* "Insoluble phosphates in the shape of coprolite powder are not worth anything in an artificial manure, for they are too insoluble to be taken up by the turnip-crop." Of what value, then, is ferric phosphate and aluminic phosphate in a manure? These experiments show, I think, that they have none whatever. But, it may be said, the manufacturer can hardly be expected to lose the phosphoric acid which has thus become unavailable. Neither, would I say, has he any right to charge it to the farmer as precipitated phosphate of lime; he should rather see that he does not pay more than the raw material which contains these objectionable oxides is worth. He will then be able to sell his superphosphate as it ought to be sold,—viz., as valuable only for that portion of phosphoric soluble in water.

At first sight it might appear that Warington's experiments on the absorptive power of soils † contradict all that I have said regarding the worthlessness of the phosphates of ferric and aluminic oxides. He endeavours to prove that hydrated ferric and aluminic oxides in the soil ultimately convert all phosphoric acid added as manure into basic phosphates of these oxides. But a careful study of his results shows, I think, that the conversion of precipitated tricalcic phosphate into ferric and aluminic phosphates is very gradual, and points to the probability of its being a long time before all the phosphoric acid could be thus transformed. My own experiments are in the same direction. In Experiment 9 I have shown how very slowly hydrated ferric oxide removes phosphoric acid from an acid solution. And again, in superphosphate, how slowly ferric and aluminic hydrates precipitate a portion of the phosphoric acid. The fact still remains, too, that root-crops are greatly increased in quantity by the addition of superphosphate of lime to the soil, from the precipitated phosphate of lime thus produced being comparatively more soluble, and easily assimilated by plants. These considerations lead me to think that the rootlets of plants abstract tricalcic phosphate from its CO_2 solution almost as quickly as it is dissolved, and before the ferric and aluminic oxides have had time to absorb any appreciable quantity of it. It is only after the roots have taken what they require that the absorptive action of these oxides will come into full play, and go on precipitating the remaining portion, to give it up very slowly again at some future period to a crop requiring little phosphoric acid; for, as the rootlets feed almost wholly on salts in solution, it is difficult to conceive how a quick-growing plant which requires much phosphoric, acid could assimilate a sufficient quantity from such insoluble materials, and ones, too, the affinities of whose components are so very great. And as, moreover, mineral phosphates are only treated with acid to make them more soluble, for the very purpose of rendering the soil more productive and increasing our crops, we are driven to the inevitable conclusion that any phosphate in a manure less soluble than precipitated tricalcic phosphate,—and certainly any less soluble than ground coprolite,—must be worthless as a fertiliser.

Such being the case, I submit that the present method of valuing a mineral from the percentage of phosphate of lime alone which it contains, is a very erroneous one, and ought to undergo some modification whereby these oxides are taken into account in the valuation. To do this, it will be necessary to calculate—1st, what we may call the "net realisable per cent" of phosphate of lime obtainable from any sample; and 2nd, the weight per cent of sulphuric acid required to reduce it to this condition. With these data, and the known composition and value of some sample taken as a standard, it will be possible to ascertain, very closely indeed, the comparative value of another mineral phosphate.

First, then, in order to find the net realisable percentage of phosphate of lime, we must know, by analysis, the actual percentage of phosphate of lime, ferric oxide, aluminic oxide, and ferrous oxide, which the mineral contains: knowing this, it is simply necessary to calculate for each of these oxides equivalent quantities of phosphate of lime, and deducting the sum of the three from the actual percentage of that earth, the remainder will be the net realisable percentage of phosphate of lime in the sample. If the ferric oxide be multiplied by the factor—

$$1{\cdot}9375, \left(\tfrac{155}{80} = 1{\cdot}9375\right),$$

the aluminic oxide by—

$$3{\cdot}0156, \left(\tfrac{155{\cdot}0}{51{\cdot}4} = 3{\cdot}0156\right),$$

and the ferrous oxide by—

$$2{\cdot}1528, \left(\tfrac{155}{72} = 2{\cdot}1528\right),$$

the amount of tricalcic phosphate equivalent to these oxides is at once found.

And, second, to calculate the weight of sulphuric acid required to reduce the mineral to the condition of net phosphate of lime, we must know the percentage of calcic carbonate, besides that of the ferric and aluminic oxides. If any peroxide of iron and alumina exist as phosphates of these oxides,—and this is sometimes the case,—such oxides are not taken into account in this calculation. The acid I propose to use has a gravity of 1·734 = 147° T., and contains 80 per cent of H_2SO_4. This is of commercial strength, so that a value can always be assigned to it.

1	molecule of	$CaCO_3$	requires	1	of H_2SO_4.
1	,,	Fe_2O_3	,,	3	,,
1	,,	Al_2O_3	,,	3	,,
2	,,	FeO	,,	3	,,

Calculating a factor for each of these, whereby the weigh of acid of the above strength may be found for all of them, we have the percentage of—

$CaCO_3$	× 1·225 =	acid at 147° T.
Fe_2O_3	× 2·297 =	,, ,,
Al_2O_3	× 3·575 =	,, ,,
FeO	× 2·552 =	,, ,,

and the sum of the products is the acid required.

It is thus assumed, that were that quantity of acid added to a mineral phosphate, and the mixture allowed to stand some time, as is the case in practice, the product would consist—so far as the bases and acids are concerned—of tricalcic phosphate, ferric phosphate, aluminic phosphate, and calcic sulphate, and the amount of the first in the mixture would be what I have called the net realisable phosphate of lime.

Before concluding, I will just go through the calculation necessary to find the value of one of these phosphates. In No. 2 sample we have—

Fe_2O_3 = 2·03	per cent	× 1·9375 = 3·93	$Ca_3(PO_4)_2$	
Al_2O_3 = 1·75	,,	× 3·0156 = 5·28	,,	
FeO = 0·34	,,	× 2·1528 = 0·73	,,	
	Total	9·94		

And 55·02 − 9·94 = 45·08 per cent of net phosphate of lime. The acid is found as follows:—

$CaCO_3$ = 24·47	per cent	× 1·225 = 29·97	acid.	
Fe_2O_3 = 2·03	,,	× 2·297 = 4·66	,,	
Al_2O_3 = 1·75	,,	× 3·575 = 6·26	,,	
FeO = 0·34	,,	× 2·552 = 0·87	,,	
	Total	41·76	,,	

* Article on Manure, in Ure's "Dictionary," vol. iii., p. 50.
† CHEMICAL NEWS, vol. xxi., p. 207.

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100 parts of this phosphate are thus shown to yield 45·08 parts of net phosphate of lime, with the consumption of 41·76 parts of sulphuric acid of 1·734 sp. gr. When Nos. 1 and 3 are calculated in the same way, we see at a glance that No. 3 is superior to No. 2, although it contains less phosphate of lime; and again, because No. 1 contains so much oxide of iron and alumina, how inferior it is to either of them.

	Net Phosphate of Lime.		Sulphuric Acid, 1·734 sp. gr.
No. 1.	24·82	with a consumption of	42·69
No. 2.	45·08	,, ,,	41·76
No. 3.	46·52	,, ,,	24·70

Taking, now, the price of vitriol at 80s. per ton, and that of the mineral phosphate No. 3 as a standard at 52s. per ton, which prices are about their present market value, we can easily calculate the comparative value of the other two: 52s. for 46·52 per cent = 1·118s. for 1 per cent. In No. 2 we have 45·08 × 1·118s. = 50·4s. per ton. But as No. 2 consumes more acid than No. 3, the value of the excess must be deducted from the price so found, to place the two on equality: 41·76 − 24·70 = 17·06 acid, at 147° T., at 80s. per ton; $= \frac{17{\cdot}06}{100} \times 80s. = 13{\cdot}65s.$, and 50·4s. − 13·65s. = 36·75s., or 36s. 9d., as the true value of No. 2 compared with No. 3 at 52s. per ton. When No. 1 is calculated in the same way, it is found to have a value of only 13·35s., or 13s. 4d. per ton.

NOTES OF WORK BY STUDENTS OF PRACTICAL CHEMISTRY IN THE LABORATORY OF THE UNIVERSITY OF VIRGINIA.

Communicated by J. W. MALLET, Ph.D., M.D.,
Professor of Analytical and Applied Chemistry, University of Virginia.

(Concluded from p. 259).

(5). *Detection of Lead as an Impurity in "Iron reduced by Hydrogen."* By Mr. J. W. C. DAVIS.

A SPECIMEN of "iron reduced by hydrogen," obtained from the eminent firm of E. Rousseau, of Paris, was found to contain lead to the extent of 1·287 per cent of the metal. How this impurity was introduced is not easy to imagine. Its presence is worthy of notice, in view of the pretty large doses of iron by hydrogen sometimes used in medical practice.

(6). *Analysis of Genthite (Nickel-Gymnite) from North Carolina.* By Mr. F. P. DUNNINGTON.

Among a number of minerals kindly sent by Mr. J. A. Reagan, of Tennessee, a laboratory student of last year, there were several specimens of genthite from Webster, Jackson Co., N.C., a locality at which the species is reported,* but without any chemical analysis that I have seen. It occurs as an incrustation, usually not more than a millimetre in thickness, of delicate apple-green colour and resinous lustre, translucent, and of specific gravity = 2·48 at 19° C., completely decomposable by hydrochloric acid. Some portions were greenish-white and opaque: these were rejected as having probably suffered alteration. Very carefully chosen fragments of the pure mineral, having been pulverised and exposed for some time to the atmosphere of a bell-glass over oil of vitriol, gave on analysis:—

Silica	49·89
Magnesia	22·35
Nickel monoxide	16·60
Iron monoxide	0·06
Water	12·36
	101·26

(Of the water 6·00 was lost at 100° C.)

* Dana's "Mineralogy," 5th ed., pp. 471 and 782.

The analysis is not a very satisfactory one, the sum of the constituents found exceeding 100 per cent of the mineral by rather more than a reasonable allowance of error. It was not repeated, from want of sufficient material from which to select fragments that could be relied upon as pure.

So far as the above numbers go, however, they do not correspond to the formula assigned to genthite, namely, $(\frac{1}{3}(MgO,NiO)+\frac{1}{3}H_2O)_2,SiO_2+\frac{1}{3}H_2O$, *i. e.*, deweylite or gymnite with MgO partly replaced by NiO, but (with the whole of the water) more nearly represent a nickel-*aphrodite*, $(MgO,NiO),SiO_2+\frac{1}{3}H_2O$. The previously recorded analyses of genthite from other localities do not agree well with each other, and leave room for useful revision.

(7). *Analysis of a Mineral from Webster, Jackson Co., North Carolina.* By Mr. F. P. DUNNINGTON.

In the same lot of minerals in which the genthite was received there was a specimen of a material much resembling in appearance pimelite from Silesia, but which proved to contain no nickel. It was massive, with indistinct traces of fibrous structure, moderately brittle, with earthy fracture, of slightly yellowish apple-green colour and greenish-white streak, dull on fractured surface, with faintly greasy lustre where cut or rubbed, feeling greasy to the touch, not adhering to the tongue, hardness = about 1·25, sp. gr. = 2·30 at 18° C. It was infusible before the blowpipe, gave off water when heated in a closed tube, and was partly, but not completely, decomposed by strong hydrochloric acid.

Its analysis afforded the following results, the mineral having been previously dried in *air*, at ordinary temperature and pressure, over sulphuric acid:—

Silica	43·87
Alumina	22·21
Iron monoxide	16·14
Soda	1·05
Water	16·37
	99·64

(Of the water 3·54 was lost at 100° C.)

These figures, if we neglect the small amount of alkali, lead to the formula—

$$2(\tfrac{1}{3}(FeO)_3,\tfrac{1}{3}(H_2O)_3,\tfrac{1}{3}Al_2O_3),3SiO_2+\tfrac{2}{3}H_2O,$$

which is not that of any hitherto-described species; but the mineral, though uniform in character, is in all probability a product of alteration, and it seems unwise to add—by another new *name* for a so-called species—to the already long list of such ill-defined hydrous silicates of earthy character.

(8). *Analysis of a Compact Talc from North Carolina.* By Mr. J. B. ADGER.

Amongst the minerals above referred to there was a very beautiful "soapstone, from the Nantahela Mountains, 8 miles from the mouth of Nantahela River, Swayne Co. (formerly Cherokee Co.), N.C." It had been sawn into slabs of about 1¼ inches thick, was very uniform in character, compact, with indistinct traces of foliated structure, white with a faint greenish shade, lustre pearly, streak white, moderately translucent, greasy to the touch, hardness = about 1·25, sp. gr. = 2·82. It resembled somewhat the finer and light-coloured specimens of Chinese jade or nephrite. Analysis afforded—

Silica	57·72
Magnesia	33·76
Alumina	2·52
Iron monoxide	0·64
Water	6·01
	100·65

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If the silica, magnesia, and water, alone be considered, the above numbers correspond pretty closely to the formula $(\frac{1}{3}MgO+\frac{1}{3}H_2O),SiO_2+\frac{1}{3}H_2O$.

The mineral is obviously distinct from the foliated talc from Webster, Jackson Co., N.C., analysed by Genth (*Am. J. Sci.*, II., xxxiii., 200, as quoted in Dana's "Mineralogy," 5th ed., p. 453). In the latter 0·23 per cent of nickel oxide was found, and but 0·34 per cent of water.

In the mineral now described there is no nickel.

University of Virginia
March 12, 1872.

NOTE ON A PORTION OF THE INCRUSTED SURFACE OF A BLOCK OF JEW'S TIN.

By J. H. COLLINS, F.G.S.,
Secretary of the Royal Cornwall Polytechnic Society.

AT a recent meeting of the Royal Institution of Cornwall, a block of "Jews' tin," from Tremethack Moor, in Madron, just purchased for the Institution, was exhibited for the first time to the members. This block was partially covered with a hard and brittle brown coating, in some places as much as ¼ inch thick. Mr. W. Jory Henwood, F.R.S., the late President, before the expiration of his term of office, placed a portion of this coating in my hands for analysis.

The brown colour was not evenly distributed, some parts being darker than others; and under the microscope several minute shining particles were visible—probably particles of metallic tin. The specific gravity of the substance was 5·64.

After a few preliminary trials I found I had just 48 grains at my disposal, which I had previously reduced to a fine powder. On drying this powder, at a temperature of 120° C., it was reduced to 45 grains.

The powder was boiled with distilled water for a time, and yielded a solution from which I obtained 0·5 gr. of tin and 0·3 gr. of chlorine = 0·8 gr. of $SnCl_2$. The powder was then digested with aqua regia, when the solution so obtained yielded 0·5 gr. of peroxide of iron, 0·21 of tin, and 0·2 silica. What remained after this treatment was dark brown, very heavy, and much like ordinary "black tin" of good quality, in appearance: when dried it weighed 43·2 grains. This was reduced in a crucible by cyanide of potassium, and yielded 34·12 grains of metallic tin = to 43·5 grs. of SnO_2.

The quantities thus obtained were calculated to percentages, with the following result:—

Moisture evolved at 120° C.	6·25
Metallic tin	0·43
Chloride of tin	1·66
Peroxide of tin	90·62
Peroxide of iron	1·04
Silica	0·41
	100·41

The crust therefore appears to be composed chiefly of peroxide of tin, somewhat resembling that native variety of cassiterite called "wood-tin," but neither so hard nor so heavy. It has no doubt been formed by the slow oxidation of the outer surface of the block of metallic tin. The slowness of the change is, perhaps, indicated by the dense condition of the incrustation.*

* On a similar sample of the same specimen, Mr. James Napier, F.C.S., remarks (20th December, 1871):—
"The incrustation which invests the mass of *Jew's-house tin* from Tremethack Moor is a pure peroxide of tin with a mere trace of iron; in short, the metal has been re-converted into *tin-stone*. This is of exceeding interest, as it shows how pure the metal must have been. All analyses of ancient bronze, however, show that the earliest are of the best quality."

APPLICATION OF ELLIOTT'S PROCESS TO THE DETERMINATION OF CARBON IN BONE-COAL GRAPHITE, ANTHRACITE, &c.

By F. A. CAIRNS, A.M.

THE employment, for a long time of Elliott's modification of Uhlgren's process, for the determination of total carbon in cast-iron and steel, as described in the *Journal of the Chemical Society of London*, May, 1869, led me to the application of it, to determining graphite alone, and then to determining carbon in bone-coal and anthracite and bituminous coals, by oxidising directly with chromic and sulphuric acids, in Elliott's apparatus. The advantages of the method are decided in point of time, ease, and neatness, in all the applications of it that have been tried here. In point of accuracy it has not been found inferior to any other. There seems to be an impression with many that nothing equals the old process of combustion in a current of oxygen, but where the oxidation by chromic acid is carefully conducted the results seem to be equally good.

The method proposed by W. D. Herman, in the *Journal of the Chemical Society of London*, June, 1870, for the direct combustion of iron and steel, seems to be superior in point of time and directness.

These advantages are enough to recommend the method, although the results are generally by Hermann's figures a little low, were it not for the expensive and troublesome apparatus required.

The delay in filtering the carbon complained of by Herman is probably owing to the use of funnel tubes of insufficient capacity. The same difficulty has occasionally been encountered here, owing to the cause suggested. The determination of total carbon, or graphite, generally occupies from 5 to 6 hours, after the substance has been prepared. Elliott's method of separating carbon seems peculiarly adapted to steel, the difficulties attending it, by Weyl's and other similar methods, being, as is well known, extremely great.

It is unnecessary, perhaps, to allude to matters of manipulation, as Elliott has given very explicit directions. One point which he does not speak of seems worthy of notice, that is, the final weight of the absorption-tube.

If it should have been standing unused for any considerable length of time previously, it should not be weighed after the operation until it has stood some hours with stoppers on the points, to allow it to become thoroughly cooled. Neglect of this precaution may cause an error of one or two tenths of 1 per cent. It has also been found advantageous to apply an aspirator at the beginning of the operation, to prevent the possibility of loss of carbonic acid, through the rubber joints, in consequence of great pressure, caused by rapid evolution of gas.

The method, as applied to total carbon in iron and steel, has been thoroughly tested by others.

To test its accuracy in respect to graphite four equal weights of iron were treated by the ordinary method, and in an exactly similar manner to separate the graphite.

The first was oxidised by Elliott's method, giving 1·50 per cent carbon.

The second was burned in oxygen as usual, giving 1·50 per cent carbon.

The third was treated by Elliott's method, giving 1·493 per cent carbon.

The fourth was lost.

The time consumed was about the same, while all the disagreeable concomitants of furnace combustions, preparation of combustion-tube, &c., and accidents, were avoided by following Elliott's method.

Two samples of bone-coal were then heated by combustion in oxygen, and by oxidising directly with chromic acid.

One gramme of the first was burned in oxygen, and the carbonic acid in the ash determined and assured,

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giving, after deducting the carbonic acid due to carbonate of lime in the coal, 8·29 per cent carbon.

One-half of a gramme of the same coal was then heated directly with chromic and sulphuric acids, and, after deducting carbonic acid due to carbonates as before, gave 8·20 per cent carbon. One gramme of the second was then burned in oxygen, &c., and gave 10·25 per cent carbon.

One-half of a gramme of the second, treated with chromic acid, &c., gave 10·28 per cent carbon.

The results were so satisfactory that other determinations have been made and compared, and the method adopted in these laboratories for a long time past.

The ordinary method of determining the carbon in bone-coal by loss on igniting the residue, insoluble in chlorhydric acid (previously dried and weighed on a tared filter), is not only imperfect, but involves more time and labour than the oxidation by chromic acid, by which method the determination can be made in less than one hour. saving the delay incident to the cooling of the tube, as suggested before.

The next experiments were made upon anthracite and bituminous coals.

The first taken was a Lehigh anthracite.

The oxygen combustion gave 91·72 per cent, and 91·68 per cent carbon. The direct oxidation by chromic acid and sulphuric acid gave 91·78 per cent carbon. A bituminous coal from Carmelsville, Pa., was then tried. This was a caking coal, and gave a great deal of trouble in the oxygen combustion, with very varying results, viz., 81·29, 82·61, 83·64, and 82·34 per cent. The oxidation with chromic acid gave 83·74 per cent carbon. The operation proceeded with rapidity and ease. In the case of coals, the oxidation should proceed rather slowly, and of course the substance should be very finely pulverised.

Substance.	Weight in grms.		Method.	Time.	Per cent of carbon.
Graphite	1		$H_2CrO_4+H_2SO_4$	5 hrs.	1·500
,,	2		Combustion in oxygen	5 ,,	1·500
,,	3		$H_2CrO_4+H_2SO_4$	5 ,,	1·493
Bone-coal	1·000	1	Combustion in oxygen	3 ,,	8·290
	0·500		$H_2CrO_4+H_2SO_4$	1 ,,	8·200
,,	1·000	2	Combustion in oxygen	3 ,,	10·250
	0·500		$H_2CrO_4+H_2SO_4$	1 ,,	10·280
Anthracite.	0·300		Combustion in oxygen	4 ,,	91·720 91·680
	0·100		$H_2CrO_4+H_2SO_4$	2 ,,	91·780
Bituminous coal.	0·200		Combustion in oxygen	4 ,,	81·290 82·010 83·640 82·340
	0·100		$H_2CrO_4+H_2SO_4$	2 ,,	83·740

Note.—Since writing the above, my attention has been called to two articles in the *American Journal of Science*, of 1848, by Prof. R. E. Rogers and Prof. Wm. B. Rogers, of the University of Virginia, on the determination of carbon in graphite, and the oxidation of the diamond, by means of bichromate of potash and sulphuric acid, with good results, at least as to graphite. By combustion of native graphite in oxygen they obtain 94·16 per cent of carbon, and by the oxidation by means of chromic acid 94·56 per cent. They give no figures in the case of the diamond.

From this it would seem that they are entitled to the suggestion of the use of chromic and sulphuric acids for the determination of carbon.—*American Chemist.*

METHOD OF DETECTING SMALL QUANTITIES OF SUGAR IN URINE.

By J. SEEGEN, M.D., Professor in the University of Vienna.

Trommer's is the most reliable and delicate test for sugar. With its aid, I am able with certainty to make out 0·3 milligramme (0·0046 grain) of sugar dissolved in 10,000 times the amount of fluid. This great delicacy of the test, however, only holds good as long as we have to do with a watery solution of sugar. If, on the contrary, small quantities of sugar are to be detected in urine, Trommer's test is neither delicate enough nor reliable, for two reasons. (1). Urine contains certain substances (colouring matters, creatine) which prevent the suboxide of copper when formed from being precipitated; no separation of the reduced suboxide of copper, therefore, takes place, the blue fluid only becoming yellow or yellowish brown, or presenting a turbid discolouration. (2). The same processes of reduction are also brought about by uric acid; and urine containing a considerable amount of uric acid acts on Fehling's test-fluid exactly in the same manner as urine containing 0·1 to 0·2 per cent of sugar.

The method devised by me has for its object the exclusion of those other constituents of urine which would disturb the proper action of the test, and the transformation, as it were, of the saccharine urine into a watery solution of sugar. Animal charcoal has the property of retaining most of the constituents of urine, more especially the colouring matters and uric acid. After filtering a watery solution of uric acid through animal charcoal I could (provided the charcoal had been good), after repeated filtrations, not find a trace of uric acid in the filtered fluid. Now, in order to detect small quantities of sugar in urine, I proceed in the following manner.

I filter one or two ounces of the urine several times through good animal charcoal until the urine is completely colourless. This operation only takes a few minutes. Then I wash the charcoal on the filter with a little distilled water, and to this water, when filtered off, I apply Trommer's test. The water with which the charcoal has been washed is almost as sensitive to Trommer's test as a watery solution of sugar, and in it I could detect even 0·01 per cent of sugar by a beautiful red precipitate of suboxide of copper, whilst the original saccharine urine, when not filtered, only produces a yellow discolouration of Fehling's test-fluid. With urine containing a little more sugar—say, 0·1 to 0·2 per cent—the water flowing off from the second and third washing acts even more energetically upon the test-fluid than that of the first washing, producing an even purer deposit of suboxide of copper. The water obtained by the subsequent washings thus evidently contains the sugar in a purer form. With normal urine, the water obtained by the above process is either entirely inactive towards Fehling's test-fluid, which remains blue, or it assumes only after a while a slight dichroid (varying colour according as the light falls on or passes through) turbidity. The water obtained by a second and third washing always remains without any effect. When the quantity of sugar has to be determined, the urine must not be filtered through charcoal, as the latter always retains a certain quantity of the sugar which cannot be removed again by washing.—*British Medical Journal.*

NOTICES OF BOOKS.

A Series of Chemical Labels for Use in Laboratories, &c. Published by Mottershead and Co., 1, Market Place, Manchester.

We notice this book of labels because it supplies one of the chief wants of the laboratory—a label clearly printed and having no peculiarity. The common names have been adhered to, prefixes and suffixes being employed only when absolutely necessary; no symbols are attached, but space has been left for the chemist to write them according to his own views. The labels for substances in common use are in duplicate, while the adjective terms "Pure," "Commercial," &c., are provided upon separate slips. We recommend these labels to the notice of every chemist.

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CORRESPONDENCE.

THE EVIDENCE OF EXPERTS.

To the Editor of the Chemical News.

SIR,—In your valuable paper there has recently appeared an article entitled "The Evidence of Experts" republished from the *Scientific American*, which, through an erroneous statement, implies an injurious reflection upon several eminent gentlemen. For this reason I trust you will, in the interest of fair play, give room for this brief correction. Had the mis-statement not found its way into a foreign journal it would have been unnecessary to refer to it, since it is part of the history of a chemico-legal investigation in a recent poisoning case, which, while in progress, excited so much attention that every newspaper-reading person in this country is familiar both with the result of the chemical testimony and the names of the experts involved.

The article opens as follows:—"In Philadelphia we have had recently the spectacle of a professed chemist and toxicologist making an examination of the body of a man supposed to be poisoned, and carrying his investigation far enough to convince himself of the presence of antimony; and, forgetting that there was a jury and a public to convince as well, appearing on the witness stand without a particle of proof that he found it except his bare assertion," &c.

The statement that this case (which is none other than the celebrated Wharton poisoning case, tried at Annapolis, Maryland) was tried in Philadelphia is untrue, and the inference which one unfamiliar with this fact must draw, upon reading the sentence, is plainly that a Philadelphia chemist "afforded the spectacle," &c. The injustice of this inference will be apparent when I state that the person affording the spectacle was a citizen of Baltimore; and that the share which Philadelphia chemists had in the case was the honourable one of exposing the untrustworthiness of a bungling analysis, and thus securing the acquittal of the prisoner.—I am, &c.,

WILLIAM H. WAHL.

Franklin Institute, Philadelphia,
May 20, 1872.

WATER ANALYSIS.

To the Editor of the Chemical News.

SIR,—In your paper of the 15th March, I notice a letter from Assistant-Surgeon Nicholson, in which he states that the analyses which have been made during the past four years of the waters of military cantonments in Bengal were made upon a method drawn up in neglect of the peculiarities of Indian waters, and that, in consequence, the results were in most cases erroneous, and, from a chemical point of view, worthless. I might simply meet this assertion by another, namely, that the method which was employed was directed, so far as needful, to the case of Indian waters, and that as, when I drew up the scheme, I had been engaged in analysing Indian waters for over fifteen years, I knew very well what those peculiarities are. I might also add that the reports of the analysts who used this method, which have been included in my reports to the Government of India on the subject of the analysis of potable waters, have gained the marked approval of the Army Sanitary Commission, as well as of Dr. Parkes and Dr. Angus Smith.

The peculiarities to which Dr. Nicholson specially refers are the frequent presence in Indian waters of a large quantity of nitrates in a sample which is free from organic matter, and *per contra* of water contaminated with sewage containing little or no nitric acid. These, however, are facts which have been not only recognised by me, and by analysts who have worked under my guidance, but also by Dr. Angus Smith, who, in a pamphlet which he wrote upon the subject,—one, by the way, to which I was much indebted in drawing up a scheme for use in Bengal,—drew attention to these very points, and urged their consideration upon those engaged in water analysis. I should hope that no one would think of condemning a water simply because it contained a large quantity of nitrates or of chlorides, though he would do well to remember that, under some circumstances, if positive, the presence of either in any quantity would be a warning not to be despised.

I willingly allow that the scheme of analysis of potable waters which I drew up six years ago, for the use of our water analysts, needs great modifications; but these have been introduced in the revised scheme which, in communication with Dr. Angus Smith and Dr. Parkes, I compiled under instructions from the India Office, when I was lately on furlough. This more recent scheme includes the admirable methods of water analysis introduced by Messrs. Wanklyn and Chapman. I may, however, say that the old scheme was very much modified by me in communication with the individual analysts, and in particular Messrs. Wanklyn and Chapman's processes were introduced so far back as 1868.

While carrying out the analysis of the potable waters of Bengal and adjacent Presidencies, I had to bear in mind that our analysts were not for the most part trained chemists; and, therefore, to have asked from them complete analyses of the mineral constituents of water would have been, for more reasons than one, a very unwise proceeding. Nor do I think that such analyses are generally needful; and I may conclude by saying that if I were now instructed by Government to do over again the work lately done in Bengal, I should feel much inclined to put into the hands of the analysts Messrs. Wanklyn and Chapman's work on water analysis, with instructions to work by it, supplementing the chemical with a microscopical examination of the waters, and charging them, as I have always done, to bear in mind that by no method of analysis can we with certainty detect all dangerous matters in a water, while, however, we may with certainty exclude danger by strict attention to the sanitary condition of the water source.—I am, &c.,

F. N. MACNAMARA, M.D.
(Surgeon Indian Army, Chemical Examiner to the Government of India).

Medical College, Calcutta,
April 19, 1872.

ATOMIC THEORY.

To the Editor of the Chemical News.

SIR,—It is evident that "An Aggrieved Atom" is labouring under a misconception of the statements made in the paper referred to. A little thought would have shown him that Whately's definition does not apply to the law of multiple proportions, seeing that the several instances do not "exhibit a conformity to that statement."

It is a very common saying, that the law of multiple proportions is a fact which will remain as one of the bulwarks of the science, whatever becomes of the atomic theory; but nothing is more certain than that the so-called law is completely dependent upon that theory. By the examination of some simple bodies, such as carbonic oxide and carbonic acid, olefiant gas, and marsh gas, Dalton obtained results which led him to think that the elements combined in multiple proportions; but his analyses were further from the theoretical numbers than those now obtained, although the latter do not lead to that law. These discrepancies are overlooked by the use of the atomic theory, but without that theory no law of multiple proportions does exist.—I am, &c.,

R. W. ATKINSON.

University College Laboratory,
May 28, 1872.

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MISCELLANEOUS.

Chemical Society.—On Thursday last, May 30th, Professor Cannizzaro, of Palermo, delivered the "Faraday Lecture" before a large audience, including a number of ladies. The Lecture Theatre of the Royal Institution had been kindly lent to the Chemical Society for this purpose, and we hope in our issue of next week to be able to lay before our readers a tolerably full abstract of the learned Professor's discourse, entitled "Considérations sur quelques Points de l'Enseignement Théorique de la Chemie." On Friday a dinner was given to the Professor, at which about 150 were present, including the Italian Ambassador and the Right Hon. the Chancellor of the Exchequer.

Improved Blowing Apparatus for Blowpipe Operations.—The *Berg-und-hütttenmännische Zeitung* contains the following description of an improved blower, by Messrs. Armin, Junge, and K. Mitzopulos, of Freiburg. All workers with the blowpipe are well aware how much the work is facilitated by a good blowing apparatus. In qualitative operations it can be dispensed with, but there are certain assays—such as concentrating cupellations for poor silver ores—which cannot be carried on without a blower, save with great exertion. For this reason, nearly every one who has quantitative assays to make provides himself with a blowing apparatus. The ordinary blowing apparatus consists of three parts,—the caoutchouc bellows, the regulator, and the stand for the nozzle. The part which most easily gets out of repair is the caoutchouc regulator, for the operator, looking at his assay, often does not perceive how the regulator gets too much stretched by the blast; the consequence is that the regulator often bursts. When we recollect that such regulators are not to be had everywhere, and that a reserve stock is often useless, from the caoutchouc getting hard, it becomes important to find a substitute which will give as regular a blast and can be made of a more lasting material. It is this that we have had in view in making our regulator, and we will proceed to explain its mode of construction for the benefit of those who might happen to want one. Our regulator gives a perfectly constant blast, which can be used either for the oxidising or the reducing flame, and, after numerous trials, we can say that it is in no way inferior to the caoutchouc regulator. At the same time it is so simple that it can be constructed with great ease, and in a very short time, The arrangement is as follows:—A common wide-mouthed bottle is carefully fitted with a caoutchouc cork bored with two holes, into each of which passes a piece of glass tube bent at a right angle. On to one of these tubes is slipped the caoutchouc tube coming from an ordinary caoutchouc bellows, whilst the other is put in communication with the blowpipe nozzle by means of four pieces of caoutchouc tubing joined by three pieces of glass tube, drawn to a fine point at each end. This forms the main peculiarity of the arrangement. When air is forced into the bottle by the blower, in jerks, it finds a difficulty in escaping as fast as it comes in, on account of the six fine openings in the glass tubes that it has to pass through on its way from the bottle to the nozzle, and it thus acquires a certain pressure in the bottle, and flows out towards the nozzle as a regular blast. The bottle may be about 6 inches high by 3½ inches wide, with a neck 1½ inches in diameter; but of course the dimensions are of no great importance. On the whole a somewhat large bottle is better than a small one. The pieces of glass tubing we use are 2 inches long by ½ of an inch in diameter. The apparatus will be stronger if instead of a glass bottle a tin cylinder is used, about 4 inches high by 2 inches in diameter, with two tin tubes opening into its top. Small metal cylinders, with a fine hole at each end, may be used instead of the little glass tubes. A blowing apparatus constructed in this manner will deliver a perfectly regular blast, and will be of practical interest to those who are thinking of working in places where it is difficult or impossible to repair the ordinary instruments.

Oxygen and Oxyhydrogen Gas.—A lively discussion is going on, in scientific and other circles, relative to MM. Tessié du Motay and Co.'s proposals for applying oxygen gas to the lighting of streets and houses, and also to manufacturing purposes. M. Tessié du Motuy's process has been public for some time. It consists, in a few words, of charging elliptical retorts each with 300 kilos. of a mixture composed of 3 parts of manganate of soda and 1 part of oxide of copper intimately blended together. Those retorts are said to yield each 35 cubic metres of oxygen gas in eight operations, each occupying three hours. Eight such retorts are in working order at the Company's Works at Pantin. A steam-engine of 20 horse-power nominal is used to inject compressed air into the retorts, to compress the gas in the cylinders, and to supply the necessary steam for the disengagement of the oxygen. The applicability of the mixed gases to lighting purposes is discussed with much asperity, but this may be attributed in part to objections of the Gas Company which supplies all Paris, and naturally is tenacious of its monopoly. MM. Tessié du Motay and Co. have, however, applied to the Municipal Council of the city for permission to lay down mains and supply-pipes for the distribution of oxygen, and it is believed that the application will be acceded to. The price of the gas is also fiercely disputed. On the one hand, it has been declared that the actual working cost is not more than 15 centimes the cubic metre, while, on the other hand, it is asserted that it cannot be sold at a profit at a lower rate than 1f. 70c. the cubic metre: the Tessié du Motay Company would seem to have settled this latter question, by issuing a public notice, to the effect that as soon as the mains and pipes can be laid down, oxygen gas will be sold to the public—either for lighting purposes, the smelting of metals, or other manufacturing purposes, and, above all, for the purification of the air in houses and hospitals—at a price not exceeding 1 franc the cubic metre, the Company taking upon itself the entire cost of the necessary means of supply. The subject is one of great interest, and as M. Tessié du Motay and his partners ought certainly to know what their products cost, there seems a fair probability that pure oxygen will be placed at the disposition of the manufacturer at a moderate cost. The application of this gas to business purposes seems far more promising than that of its general use in street or house lighting. The necessity for two sets of pipes and two meters, one for each of the gases, and the nicety required in regulating their proportions, are likely to present considerable difficulties in practice.—*Journal of the Society of Arts.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, April 29, 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Researches on Crystalline Dissociation.—P. A. Favre and C. A. Valson.—The second instalment of an exhaustive monograph on this subject, elucidated by a series of tabulated forms exhibiting results of experiments.

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Constitution of Clay.—P. de Gasparin.—The author communicates the analysis of a sample of clay taken from the plain of the Vistre not far from Nimes (Département du Gard), this soil being noted for its great fertility. The results of the physical analysis are, in 100 parts—Stones, 1·85; sand, 50·35; matter impalpable and soluble in water, 47·80. Chemical analysis, in 100 parts—Insoluble in nitro-hydrochloric acid, 58·96; soluble in nitro-hydrochloric acid—Carbonate of lime, 27·84; carbonate of magnesia, 0·89; potassa, 0·225; soda, 0·105; peroxide of iron, 4·35; alumina, 2·03; water of combination, 1·45; phosphoric acid, 0·146 (this is equivalent to 6 tons per hectare of surface of the land); organic matter, 4·004.

Absorption-Spectra of the Vapours of Selenium, Protochloride and Bromide of Selenium, of Tellurium, Protochloride and Protobromide of Tellurium, of the Protobromide of Iodine, and of Alizarine.—D. Gernez.

Study on the Salt-Making Industry of Portugal.—A. Girard.—This paper treats exhaustively on the mode of obtaining salt from sea-water by spontaneous evaporation, as practised in the salt-gardens of a certain district of Portugal, whereby the so-called sea-salt is obtained.

Presence of Selenium in Sulphuric Acid Made in France.—I. Personne.—It appears that the sulphuric acid obtained from a manufactory near Paris, and made from a copper-containing pyrites of French origin, contains 0·2 grm. of selenium in 3 litres of acid. As to the source whence this selenium is derived, the author is inclined to ascribe it to the pyrites used in the preparation of the acid. Sulphuric acid made from Belgium pyrites at the same works was found not to contain any selenium. The author is engaged in making further researches on this subject.

Action of Oxygen upon Certain Vegetable Infusions.—L'Abbé Laborde.—This paper contains the detailed description of an experiment made with the view to prove that active oxygen (ozone) is incapable of calling forth fermentation under the conditions alluded to.

Question of the Assimilation of Ammonia by Yeast.—Dr. Griessmayer.—After referring to some discussions which have taken place recently on this subject, the author calls attention to the fact that the ammonio-phosphate of magnesia, when boiled either along with some water and calcined magnesia or even with water alone, gives off its ammonia, which is in a short time completely expelled.

We quote the titles of the two following papers, although the subjects treated of do not precisely belong to chemistry:—

Sanitary Police in reference to Rinderpest.—Dr. Bouley.—The condensed report of the proceedings of the international conference which lately held its meetings at Vienna.

Human Skeleton Found on March 26 in the Caverns of Baoussé-Roussé (Italy) Known as the Grotto of Menton.—E. Rivière.

May 6, 1872.

This number contains the following original papers relating to chemistry:—

Process of Decorative Painting upon Tinfoil.—C. Daniel.—The detailed description of a method of painting with oil paints upon tinfoil stretched uniformly on sheets of plate glass until the painting and varnishing are finished. The tinfoil thus prepared is used instead of paper-hangings, and for decorative purposes; gilding can also be applied.

Light Emitted by the Vapour of Iodine.—G. Salet.—When a crystal of iodine is put into a hard glass tube, the tube sealed, and then strongly heated to redness at some distance from the iodine, the latter substance will be seen, after the heating of the tube has been discontinued, to become volatilised, and to exhibit when entering the still hot portion of the tube a brilliant red light. This experiment may be also made by means of a glass tube provided with a spirally-wound platinum wire, which is made red-hot by means of an electric current.

Conversion of Pyro-Phosphates into Phosphates.—M. Prinvault.—When boracic acid is fused along with pyro-phosphate of soda, and the fused mass taken up with water, there is formed ordinary phosphate of soda; the pyro-phosphate of soda has thus absorbed an equivalent of water of constitution by the action of the boracic acid. It is, the author thinks, probable that phospho-borate of soda is formed, which is decomposed by the water into boracic acid and ordinary phosphate of soda. The action of sulphuric acid, when converting pyro-phosphate of soda into ordinary phosphate of soda, is explained by the author as due to the formation of an alkaline phospho-sulphate.

Quantitative Estimation of Copper by Means of Cyanide of Potassium.—M. Yvon.—The author, first referring to De Lafollye's paper on this subject, asserts that the author just named is not the discoverer of this process. M. Yvon quotes a paper on the subject, published as far back as 1859, by Buignet (*Bulletin de l'Académie de Médicine et Journal de Pharmacie et de Chimie*, third series, vol. xxxv., p. 168). The author (Yvon) further observes that De Lafollye's assertion that the presence of iron or zinc does not interfere with the operation, is quite incorrect, since he (Yvon), who has been engaged since January last in trying to make Buignet's plan practically available, has not as yet surmounted the difficulty which the presence of these metals places in the way of making the otherwise good plan practically useful. The author continues his researches, and intends to publish a complete account thereof.

Formation of Diphenylamine.—Ch. Girard and G. de Laire.—The authors first refer to their paper, published in the *Comptes Rendus*, of 18th March last (see CHEMICAL NEWS, No. 646, April 12, 1872, page 178), and then state that, since their experiments, made according to the directions given by Dusart and Bardy, do not agree in the results obtained with those obtained by the last-named parties. They (Girard and De Laire) request that the Academy may appoint a committee to verify these matters.

This number further contains several important papers and memoirs relating to geology, paleontology, meterology, physiology, and natural history.

Le Moniteur Scientifique Quesneville, No. 364, April, 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

On Smells according to the most Recent Chemical and Physiological Discoveries.—F. Papillon.—This excellent essay, too lengthy and too concisely written for any useful abstraction, contains a large and well-digested amount of information, and is elucidated by historical details of importance.

Anthracen and its Derivatives.—Dr. E. Kopp.—The continuation of this lengthy monograph. This portion treats on the action of sulphuric acid upon bichlor-anthracen, $C_{14}H_8O_2$; action of sulphuric acid upon bibrom-anthracen, $C_{14}H_8Br_2$; preparation of alizarine; details of English patents and French *brevets*; on the state in which alizarine is found in madder. To be continued.

Use of Silicate of Soda in Soap-Making.—G. Schnitzer.—This paper contains a valuable amount of practical information relating to soap-boiling by the so-called cold process.

Manufacture of Tartaric Acid in South Germany.—Dr. Kurz.—This memoir is divided into the following chapters:—Preparation of tartrate of lime, (*a*) by means of argol, and (*b*) by means of ley of wine; treatment of the humid wine-yeast; treatment of dry wine-yeast (residues of wine-fermentation); separation of the tartaric acid from the tartrate of lime; refining of argol; estimation of the value of argol.

Bibliography.—"L'Electricité Appliquée aux Arts Mécaniques, à la Marine, au Theatre," par M. E. Saint Edme; 1 vol.; Paris: Gauthiers-Villars. It appears from the review here quoted that this is a very interesting work.

American Journal of Pharmacy, May, 1872.

In addition to several excellent papers and memoirs more particularly bearing upon pharmacy and pharmacognosy, this number contains the following original papers relating to chemistry:—

Lycopersicum Esculentum, Tomato.—T. D. McElhenie.—This paper contains the very detailed account of a series of experiments made with the fruit alluded to mainly for the purpose of ascertaining the nature of the acids present in this fruit; these acids are citric, oxalic, malic, and tartaric, the latter, however, only in very small quantity.

Yaupon.—H. M. Smith.—Under this name the Indians indicate the leaves of the *Ilex Cassine*, a plant indigenous to some parts of the southern States of the Union; these leaves, mixed with those of other species of the same plant, *Ilex vomitoria* and *Ilex dahoon*, form the cassena, the basis of their (Red Indians') famous black drink, used as medicine and as a state drink at some of their religious festivals. The constituents of the yaupon are percentically—Volatile oil, 0·011; wax and tar, 0·466; resin, 3·404; chlorophyll, 2·491; caffeine, 0·122; tannic acid, 4·844; gum and pectin, 8·244; extractive matter, 10·149; starch, pectose, &c., 15·277; nitrogenous matter, 8·138; woody fibre, 34·854; moisture, 7·595; ash, 3·935; total, 101·939. Yaupon is largely used in the southern States as a substitute for tea, coffee, and other stimulants, and is reported to be very beneficial to inebriates who wish to cure themselves of their love of liquor.

Ether Glue.—Dr. J. M. Maisch.—An excellent liquid glue is made by dissolving glue in nitric ether; this fluid will only dissolve a certain amount of glue, consequently the solution cannot be made too thick. The glue solution obtained has about the consistency of molasses, and is doubly as tenacious as that made with hot water. If a few pieces of caoutchouc, cut into scraps the size of buckshot, be added, and the solution allowed to stand a few days, being frequently stirred, it will be all the better, and will resist dampness twice as well as glue made with water.

La Revue Scientifique de la France et de l'Etranger, May 4, 1872.

This number does not contain any original papers bearing on chemistry, but we call attention to the titles of the following papers:—

Superior Agricultural Instruction at the Ecole Centrale des Arts et des Manufactures at Paris.—J. Dumas.—This excellent essay contains a clearly written *exposé* of the means adopted in France for giving instruction in agriculture, practical as well as theoretical.

Continuation of the Lectures on Animal Heat.—C. Bernard.

May 11, 1872.

This number, also, does not contain any original papers bearing on chemistry, but we notice:—

Scientific Journey to Madagascar.—A. Grandidier.—This essay, illustrated with a map, contains some very valuable and reliable information concerning an island which is considerably

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larger than France, even before the late war, Madagascar having a surface of 590,000 square kilometres.

The Mineral Waters of France.—Dr. Gubler.—An excellent therapeutic essay, from which it appears that the country just named contains most valuable mineral sources, thermal as well as cold, of various kinds.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, March 21, 1872.

Studies on the Dynamometers.—Dr. C. Mène.—The first instalment of a treatise on this subject, illustrated with woodcuts.

Volumetric Quantitative Estimation of Lead.—M. Buisson.—This process is based upon the precipitation of lead by means of bichromate of potassa, and the subsequent complete decomposition of this reagent (used in excess) by iodide of potassium in a liquor acidulated with sulphuric acid. The iodine set free is next estimated by starch and hyposulphite of soda. Although this process yields reliable results with nearly pure lead, many metals interfere with its correctness, as, for instance, silver, bismuth, copper, baryta.

Estimation of Water in Animal Charcoal.—Dr. Walz.—From a series of experiments made by the author, he comes to the conclusion that a weighed sample of animal charcoal, such as is used in sugar refineries, when exposed for an hour to a temperature of 250° F., is completely dried; a higher temperature should be avoided, since then, probably owing to oxidation, an increase of weight is observed. Animal charcoal, though apparently dry, may absorb as much as 15 per cent of water, and usually contains about from 5·5 to 7 per cent of moisture.

March 28, 1872.

Under the title—

Actualités—Dr. C. Mène—This number opens with the first instalment of a discussion on fermentation, decay, catalytic force, and ferment.

Absorption of Metallic Salts by Mordanted Woollen Fabrics.—P. Havrez.—This paper, not well suited for any useful abstraction, contains some very important results of researches relating to the practice of mordanting.

Description of a Newly-Devised Apparatus for the Economical Manufacture of Illuminating Gas.—M. Martin.—This contrivance is specially arranged for making gas from either liquid or solid volatile hydrocarbons, which are first, in a special vessel, volatilised under high pressure, and the vapours next converted into gas by passing them through a red-hot retort filled with lumps of coke. The apparatus, illustrated by a woodcut, can be placed in a kitchen, and is especially made for use in isolated houses and country places situated at a distance from large gas-works.

Les Mondes, May 2, 1872.

French Association for the Advancement of Science.—The inaugural meeting of this Association has been held under the presidency of Dr. C. Bernard, assisted by MM. Dumas, Wurtz, and Broca. After the approval of the statutes which rule this Association, an inaugural discourse was delivered by Dr. Wurtz. This newly-organised institution is akin, in its scope and arrangements, to the British Association for the Advancement of Science. In some French town or city the Association will hold a meeting annually, while it is also intended to advance science by other means.

Preparation of Caustic Soda by means of Sulphuret of Sodium.—Tessié du Motay.—The author distinguishes between processes by the dry and the wet way. The former is described as follows:—When one equivalent of sulphuret of sodium is mixed and fused with one equivalent each of caustic soda, hydrate of lime, and metallic iron (either cast or malleable), and these substances heated to redness, the sulphuret of sodium is completely converted into caustic soda, while sulphuret of iron is simultaneously formed. This reaction is explained by the author as follows:—The water of the hydrate of soda, or of the hydrate of lime, is decomposed by the iron which becomes oxidised, hydrogen is set free, oxide of sodium formed, and next sulphuret of iron; the soda is separated from the last-named substance by lixiviation with water. As regards the process by the wet way, the author converts the sulphuret of sodium into a basic phosphate of soda by means of a rather circuitous process (scientifically correct, but not well adapted for industrial application), and this basic phosphate of soda is next converted into caustic soda by means of caustic lime.

May 9, 1872.

Pathologico-Chemical Laboratory.—The Municipal Council of Paris has made the necessary arrangements to construct a pathologico-chemical laboratory to be added to the School of Practical Science established in that city.

Electro-Magnetical Apparatus for Medical Use and Physiological Applications.—MM. Trouvé and Onimus.—The detailed description illustrated by woodcuts of very ingeniously-contrived and well-arranged electro-magnetical apparatus, especially suited for medical use and physiological experiments.

Preservation of the Wood of Telegraph-Poles in Norway.—F. Michel.—The property of freshly cut down trees of continuing the circulation of the sap is made use of to cause the wood (fir trees) to absorb sulphate of copper, introduced into holes some 16 to 18 centimetres in depth, and closed by wooden plugs or corks coated with tar or varnish. The introduction of sulphate is repeated two or three times a year for a period of two or three years, during which time the poles absorb a sufficient quantity of sulphate of copper to prevent the wood from decay for ten to twelve years in the climate of Norway, where the winters are very severe, but comparatively dry.

May 16, 1872.

This number has not yet been received.

May 23, 1872.

Atelier de Silex Préhistoriques.—E. Lejeune.—The author states that he has discovered, in a secluded locality,—Escalles (Pas-de-Calais),—a workshop, wherein, aided by excellently-constructed machinery and well-made tools, pre-historic silex and quartz implements are made on the large scale, the workshop being situated in the neighbourhood of a number of tumuli.

Submarine Hydro-Electric Cable.—Rev. F. Moigno.—A preliminary notice of an invention made by F. Tommasi, whereby it is stated that telegraphic submarine communication can be obtained without the use of the ordinary electric cables, and at greatly lessened cost and very much increased rapidity of transmission of signals.

Wood-Carving by Machinery.—H. A. Lanteigne.—The description, illustrated hy a woodcut, of an apparatus for carving wood.

Bibliography.—Under this heading we meet here with an exhaustive review of the work just published:—"La Création du Monde organisé d'après les Naturalistes Anglais et Allemands," par M. Charles Martins, Professeur de Botanique à la Faculté des Sciences de Montpellier.

Petites Annales de Chimie.—Dr. Maumené.—The continuation of a series of papers on chemical philosophy.

May 30, 1872.

This number only contains the index for the first four months of this year.

MEETINGS FOR THE WEEK.

MONDAY, June 10th.—Royal Geographical, 8.30.
—— London Institution, 4. Prof. Bentley, F.L.S., "On Elementary Botany."
TUESDAY, 11th.—Civil Engineers, 8.
—— Photographic, 8.
THURSDAY, 13th.—Royal, 8.30.
—— Royal Society Club, 6.
FRIDAY, 14th.—Astronomical, 8.
—— Quekett Club, 8.

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THE CHEMICAL NEWS.

VOL. XXV. No. 655.

ON THE SEPARATION OF PHOSPHORIC ACID, FERRIC OXIDE, ALUMINA, LIME, AND MAGNESIA.*

By THOMAS ROBERTSON OGILVIE, F.C.S.

To separate and accurately estimate phosphoric acid, ferric oxide, and other bases, is one of the most difficult problems in analysis. It is also of great commercial importance, on account of the large quantities of ferruginous phosphatic minerals employed in the manufacture of superphosphate of lime: besides, owing to the increased demand of late for these minerals, they have considerably advanced in value, and merchants now ask from analysts a greater delicacy and minuteness of detail in their results than formerly. Another reason why a correct and speedy method of separation is of consequence has just been clearly shown by a member of this section, in the prominent part which ferric oxide and alumina play in the manufacture and composition of artificial manures.†

The method generally recommended is to dissolve the mineral in acid, evaporate to dryness, filter from the siliceous matter, precipitate the lime as oxalate, which, after being washed, dried, and ignited, is weighed as carbonate. The filtrate is evaporated to a small bulk, citric acid added to hold up the ferric oxide and alumina, and the phosphoric acid separated as ammonio-magnesian phosphate. To the fluid from this precipitate is added some nitrate of potash and sufficient carbonate of soda to effect the decomposition of the chloride of ammonium, the whole brought to dryness, and ignited, so as to decompose and remove the citrate and other ammoniacal salts. The residue is dissolved by digestion for some time in acid, and the ferric oxide and alumina are precipitated in the usual way. The magnesia, which is present in mineral phosphates in very small quantities, is determined in another portion of the acid solution by separating the lime with oxalate of ammonia, the ferric oxide and alumina with ammonia and acetic acid, and then allowing the filtrate—which contains a large quantity of phosphoric acid—to stand till the magnesia separates as ammonio-magnesian phosphate.

This plan of estimation is objectionable on two grounds:—first, because phosphoric acid cannot be estimated with accuracy in presence of oxalate and citrate of ammonia, if they exist in any considerable quantity; and second, because the removal of the chloride of ammonium and the decomposition of the other ammoniacal salts are tedious and troublesome operations.

Another method of separating ferric oxide and alumina is that given by Warington, in his excellent paper on "The Analysis of Mineral Phosphates."‡ To the acid solution of the mineral large excess of caustic soda is added, which gives a precipitate of ferric oxide and phosphate of lime. The iron may be estimated by the permanganate process, or separated from the phosphate of lime by dissolving in hydrochloric acid, precipitating with ammonia, and adding large excess of acetic acid, which leaves the iron as phosphate. It will contain a little lime, which may be removed by re-dissolving and re-precipitating. The filtrate from the ferric oxide and phosphate of lime contains the alumina, and is treated with chloride of barium to remove phosphoric acid, with carbonate of soda to separate the excess of baryta, and then with ammonia to precipitate the alumina. This mode of determining the oxides has not come into frequent use, owing to the great deal of manipulation involved, and because of the difficulty of obtaining caustic soda free from alumina.

About a year ago our leading agricultural chemists began to adopt Sonnenschein's method of separating phosphoric acid as phospho-molybdate of ammonia; and since then the extraordinary discrepancies previously so frequent have to some extent ceased. Regarding this process Warington, in the paper already quoted, states that "it is inadmissible, from the large amount of phosphoric acid to be determined" in mineral phosphates: and Fresenius says that "the phosphoric acid in the substance taken to operate upon should not be allowed to exceed 0·1 grm.,"* which would be equivalent to about 0·3 grm. of the mineral, a quantity so small that few chemists would care to work upon it in ordinary commercial analysis. Watts also repeats these statements: he says "it cannot be depended upon for giving exact results, excepting when the quantity of phosphoric acid to be determined is very small."† I have thoroughly satisfied myself, however, by a number of experiments, that perfectly satisfactory results may be got by employing a quantity of the substance containing even 0·3 grm. of phosphoric acid. We may therefore separate the phosphoric acid in such minerals as apatite, coprolite, Rhenish phosphorite, and South Carolina phosphate, by this highly-accurate method, and in the filtrate from the phospho-molybdate of ammonia determine the bases.

Before referring to the latter point, which is the more immediate subject of this paper, I shall briefly give the details of Sonnenschein's process.

(*a*). *Separation of Phosphoric Acid as Phospho-Molybdate of Ammonia.*—Five grms. of the finely-ground mineral are dissolved in nitric acid, evaporated to dryness so as to render any soluble silica insoluble and avoid its interfering with the subsequent determination of the bases, re-dissolved in the same acid, filtered from the siliceous matter, and the filtrate made up to 250 c.c. The siliceous matter should be free from ferric oxide; if not, it must be digested in strong acid until it becomes white, and the solution added to the original filtrate. Of the fluid 50 c.c., containing 1 grm., are transferred to a beaker, a sufficient quantity of molybdenum solution added, and the whole allowed to stand—at a temperature of 40° C.—until the precipitate thoroughly subsides, for which four hours are generally sufficient. The molybdenum solution is prepared in the following manner:—10 grms. of molybdate of ammonia are dissolved in 40 c.c. of ammonia (0·96 sp. gr.), heat applied gently, then 160 c.c. of a mixture of equal parts of nitric acid and water added, care being taken to keep down the temperature. In this way a solution of known strength is got, and little difficulty will be experienced in using the requisite quantity, namely, 40 parts of molybdic acid for every 1 part of phosphoric acid present. The phospho-molybdate of ammonia is filtered, washed with a mixture of equal parts of the molybdenum solution and water, then dissolved in ammonia, and, after neutralising the greater part of the free alkali with hydrochloric acid, "magnesia-mixture" added in *slight* excess and the phosphoric acid precipitated as ammonio-magnesian phosphate.

The filtrate from the phospho-molybdate of ammonia will contain all the bases as nitrates, and Fresenius‡ gives the following plan of separating them from the molybdic acid:—Mix the acid fluid in a flask with ammonia to alkaline reaction, add sulphide of ammonium in sufficient excess, close the mouth of the flask, and digest the mixture. As soon as the solution appears of a reddish-yellow colour, filter off the fluid which contains sulphide

* Read before the Glasgow Philosophical Society, April 29, 1872.

† "The Part which Iron and Aluminium Oxides Play in the Manufacture of Superphosphates; and on the Comparative Value of Mineral Phosphates," CHEMICAL NEWS, vol. xxv., pp. 255, 268.

‡ CHEMICAL NEWS, x., p. 1.

* Fresenius, "Quantitative Analysis." 4th edition, p. 274.

† Watts's "Dictionary," vol. iv., p. 546.

‡ "Quantitative Analysis," 4th ed., p. 285.

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of molybdenum and the alkaline earths, wash the residue of sulphide of iron and alumina with water containing a little sulphide of ammonium, and determine the oxides by the usual methods. The sulphide of molybdenum is next precipitated from the filtrate with hydrochloric acid, and the lime and magnesia estimated in the filtrate. But such a process is too troublesome and protracted for ordinary use, and I propose to render it more simple and expeditious, by taking advantage of the well-known property of molybdic acid of remaining in solution in presence of free alkali, and determining the bases in its presence.

(*b*). *Separation of Ferric Oxide and Alumina.*—The filtrate from the precipitate of phospho-molybdate of ammonia, consisting of a nitric acid solution of molybdic acid, ferric oxide, alumina, lime, and magnesia, is placed in a beaker, and cautiously neutralised with ammonia, care being taken that the temperature does not rise above 40° C., and that the alkali is added only in slight excess; allow to stand in a warm place until the precipitate completely settles, filter the clear supernatant fluid, wash the precipitate by decantation, then transfer it to a filter, and finish the washing. Next, re-dissolve the precipitate in weak nitric acid, re-precipitate, and wash in the same careful manner. If the filtrate is found to contain any lime it is added to the original solution. The precipitate is dried, ignited, and weighed as ferric oxide and alumina. By re-dissolving in hydrochloric acid the former is rapidly determined, after reduction with zinc, by Penny's bichrome process, and the latter found by difference.

(*c*). *Separation of Lime.*—The alkaline filtrate from the ferric oxide and alumina is treated with oxalate of ammonia, and allowed to stand in a warm place, until the precipitate of oxalate of lime has completely subsided, which will take place in about three hours. The clear fluid is then filtered, the precipitate washed by decantation and otherwise, dried, and ignited; care being taken that no caustic lime is formed.

(*d*). *Separation of Magnesia.*—To estimate the magnesia in the solution from the oxalate of lime, the ammonia salts must be removed by evaporating it to dryness and igniting the residue, which will leave only magnesia and molybdic acid. It is digested with a little nitric acid to dissolve the magnesia, and then neutralised with an excess of ammonia to render soluble the molybdic acid. To the clear solution phosphate of soda is added, and the magnesia removed as ammonio-magnesian-phosphate.

To test the correctness of this mode of separating phosphoric acid, ferric oxide, alumina, lime, and magnesia, a solution was prepared, containing a mixture of these bodies in known proportions, and the following are the details of the experiments. In (*a* 1) and (*b* 1) magnesia was present, and in (*a* 2) and (*b* 2) it was absent.

	Used.	Found.		Used.	Found.	
	(*a*).	(*a* 1).	(*a* 2).	(*b*).	(*b* 1).	(*b* 2).
PO_5	0·1984	0·1982	0·1989	0·0397	0·0409	0·0409
Fe_2O_3	0·0300	0·0312	0·0297	0·1500	0·1485	0·1460
Al_2O_3	0·0200	0·0208	0·0203	0·1000	0·1015	0·0980
CaO	0·3298	0·3282	0·3326	0·1319	0·1310	0·1327
MgO	0·0570	0·0555	—	0·1140	0·1146	—
	0·6352			0·5356		
Found: grms.		0·6339	0·5815		0·5365	0·4176
Used: grms.		0·6352	0·5782		0·5356	0·4216

As nearly all mineral phosphates contain only a few tenths of a per cent of magnesia, it would perhaps be preferable to take a fresh portion of the acid solution of the mineral, and separate the lime as oxalate, evaporate the filtrate to a small bulk, add ammonia, then acetic acid, and remove the ferric oxide and alumina as phosphates; then render the fluid alkaline, and allow to stand for some time, when the small quantity of magnesia will be deposited as ammonio-magnesian phosphate.

This plan of separating phosphoric acid, ferric oxide, and other bases, is simple and easy, as it involves only operations of the most elementary kind, and avoids the use of sulphuretted hydrogen. It is very expeditious the bodies may all be separated in about 12 hours,—and even this time may be shortened if the separation of the phosphoric acid, ferric oxide, and alumina, in one portion of the acid solution, and the lime and magnesia in another are gone on with simultaneously. Although the solution from the phospho-molybdate of ammonia containing the bases is of considerable volume, it may be filtered very rapidly from the ferric oxide and alumina, and then from the oxalate of lime, if the precipitates are allowed to settle properly. The method is also highly accurate; the phosphoric acid is determined by a process which may be placed in the front rank for delicacy and correctness, and the other bodies are got with all desirable precision.

NEW RESEARCHES ON THE PHOSPHORUS BASES.*

By A. W. HOFMANN, LL.D., F.R.S.,
Professor of Chemistry in the University of Berlin.

(Concluded from page 247).

IV. *Primary and Secondary Ethylic Derivatives of Phosphoretted Hydrogen.*

After what has been elicited by the study of the methyl compounds, there could be but little doubt as to the phenomena to be observed by repeating the experiments in the ethyl series. Nevertheless the study of the ethyl compounds presented an interest of its own. In the first place, it was desirable experimentally to generalise the new method by applying it to different groups; again the properties likely to be possessed by the ethylphosphines, and more particularly their higher boiling-points, appeared to promise that the experimental difficulties of this inquiry would be materially diminished by working in the ethyl series.

The formation of the ethylphosphines by means of ethyl iodide, phosphonium iodide, and zinc oxide proceeds with the same facility and precision as that of the methylated compounds. The digestion, however, must be conducted at a somewhat higher temperature. Exposure of the tubes to a temperature between 140° and 150° C. for six or eight hours is sufficient for the transformation. The product of the reaction in this case, exactly as in the methyl series, contains the primary and secondary bases only. Their separation and preparation in a state of purity is carried out in exactly the same manner as that of the corresponding methyl compounds.

Ethylphosphine—

$$C_2H_7P = \left.\begin{matrix} C_2H_5 \\ H \\ H \end{matrix}\right\} P.$$

Colourless, transparent, mobile liquid, powerfully refractive, lighter than water, in which it is insoluble. It is easily soluble in alcohol and ether. These solutions are without any action on vegetable colours. Ethylphosphine boils constantly at 25°, and is then seen to possess exactly the boiling-point of dimethylphosphine with which it is isomeric.

$$\left.\begin{matrix} CM_3 \\ CM_3 \\ H \end{matrix}\right\} P = \left.\begin{matrix} C_2H_5 \\ H \\ H \end{matrix}\right\} P = C_2H_5P.$$

The odour of this compound is overwhelming; it strongly recalls that of the formonitriles, producing more especially the same sensation of bitterness on the tongue and to the very depth of the throat. Odour and taste are, obviously, in consequence of the volatility and oxidability of the compound, far less persistent. The vapour

* A paper read before the Royal Society.

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of ethylphosphine bleaches cork like chlorine; very peculiar, too, is its action on caoutchouc, which in contact with it becomes translucent, losing its elasticity. Chlorine, bromine, and nitric acid inflame the compound. Ethylphosphine combines with sulphur and carbon bisulphide, though not nearly as energetically as triethylphosphine; nor are the compounds thus produced crystalline, like the corresponding derivatives of triethylphosphine, but liquids, which are as yet but imperfectly studied.

Like the monomethylated base, ethylphosphine unites with chlor-, brom-, and iod-hydric acids to saline compounds. The solution of the chlorhydrate yields with platinum perchloride a double salt, crystallising in fine crimson-red needles, which resemble freshly-prepared crystallised chromic acid. The most beautiful salt of ethylphosphine is the iodhydrate. It forms white four-sided tables, which, in a current of hydrogen, may be sublimed even at the temperature of boiling water. The aspect of the substance forcibly recalls that of ordinary sal-ammoniac. Analysis showed that this salt possesses the composition assigned to it by theory, viz.:—

$$C_2H_8PI = (C_2H_5)H_2P.HI.$$

The iodhydrate easily dissolves in water, but not without being entirely decomposed. In dry air the crystals of the salt are permanent; but even when breathed upon they are altered, their decomposition being indicated by the powerful odour emanating from the crystals, which, when dry, are perfectly inodorous. When a crystal is thrown upon water, it is seen to disappear with evolution of gas. Alcohol dissolves the iodhydrate, but only with partial decomposition; in ether it is insoluble. The only solvent in which the salt was found to be soluble, though likewise but sparingly, is concentrated iodhydric acid. Addition of ether to this solution causes the salt to separate in large, well-formed tables, having often a length of 1 centimetre; they are generally so thin that their surface presents magnificent iridescence.

Diethylphosphine—

$$C_4H_{11}P = \left.\begin{matrix} C_2H_5 \\ C_2H_5 \\ H \end{matrix}\right\} P.$$

Transparent, colourless, perfectly neutral, mobile liquid, floating upon water, in which it is insoluble, powerfully refracting light. It boils constantly at 85°, *i. e.* 66° higher than the primary base. The odour is penetrating and most persistent, very different from that of ethylphosphine, distantly resembling that of triethylphosphine. The diethylated compound attracts oxygen with far more energy than the primary base; and more than once have I seen this compound bursting into flame on opening a bottle. Diethylphosphine combines with sulphur and carbon bisulphide; these combinations, like those of the monoethyl base, are liquids.

The secondary phosphines readily dissolve in acids. The salts, as far as my experience goes, are difficult to crystallise, with the exception of the iodhydrate. The solution of the chlorhydrate gives, with platinum perchloride, a fine platinum salt, crystallising in orange-red prisms, which are, however, easily changed. It is interesting to perceive that the salts of diethylphosphine resist the action of water, whilst those of the monoethylated base are readily decomposed; the deportment of the phosphines is thus seen to afford an instructive illustration of the increased basicity the phosphoretted molecule acquires with the number of ethyl groups it has incorporated.

Products of Oxidation of the Primary and Secondary Ethylphosphines.

It is my intention to study in detail the products of oxidation of ethyl- and diethylphosphines, which, according to special circumstances, appear to vary to a considerable extent. Hitherto I have examined only the terminal compounds. These are perfectly analogous to the products similarly obtained from the methylated base; they need not, therefore, be more than cursorily mentioned.

Ethylphosphine Acid.—Preparation, appearance, and properties of the body obtained by the action of nitric acid upon ethylphosphine resemble in every respect methylphosphine, and described in a previous communication. The ethyl compound is likewise exceedingly soluble in water, alcohol, and ether; it fuses at 44°, and may be distilled without decomposition. The formula $C_2H_2PO_3 = (C_2H_5)H_2PO_3$ was fixed by the analysis of a silver salt. This salt was formed by saturating the free acid partially with silver oxide, and precipitating the concentrated liquid by alcohol. It is an amorphous, yellowish powder, insoluble in water and alcohol, the composition of which is represented by the formula

$$(C_2H_{11})Hg_2PO_3.$$

Diethylphosphinic Acid.—On treating diethylphosphine with nitric acid, all the phenomena present themselves which are observed in the corresponding experiment in the methyl series. The acid produced, however, has only been seen as yet in the liquid state, refusing to solidify even at a temperature of 25°. The composition of the acid, $C_4H_{11}PO_2 = (C_2H_5)_2HPO_2$, was established by the analysis of a silver compound. The latter was obtained by nearly neutralising the acid by silver oxide and precipitating the evaporated liquid by alcohol. The silver diethylphosphinate contains

$$C_4H_{11}HgPO_2 = (C_2H_{11})_2HgPO_2.$$

The product of oxidation of the ethylated phosphorus bases are thus proved to be perfectly analogous to the group of methyl bodies previously described, as seen by glancing at the following table:—

Orthophosphoric acid, $\left.\begin{matrix} HO \\ HO \\ HO \end{matrix}\right\}$ PO.

Ethylphosphinic acid, $\left.\begin{matrix} C_2H_5 \\ HO \\ HO \end{matrix}\right\}$ PO.

Diethylphosphinic acid, $\left.\begin{matrix} C_2H_5 \\ C_2H_5 \\ HO \end{matrix}\right\}$ PO.

Triethylphosphinic oxide, $\left.\begin{matrix} C_2H_5 \\ C_2H_5 \\ C_2H_5 \end{matrix}\right\}$ PO.

V. *Aromatic Phosphines.*

The well-defined results which the easy and handy use of phosphonium iodide, as a source of phosphorus compounds, has furnished in the methyl and ethyl series, and, as I shortly intend to communicate to the Society, also in the propyl, butyl, and amyl series, very naturally created the wish of drawing the aromatic phosphines as well into the circle of my researches. It appeared especially worthy of interest to study an aniline with phosphorus in the place of nitrogen,—in other words, phenyl phosphine and, indeed, the whole series of phenylated phosphorus bases. I have instituted many experiments in the hope of obtaining these bodies, but as yet without success. Considering the remarkable inactivity of benzol chloride and analogous benzol compounds under the influence of ammonia, I could scarcely hope to form phenylphosphine by acting on phosphonium iodide with benzol chloride. Nevertheless the experiment was made; but although tried under varying conditions, I have not been able to observe the generation of phosphine bases in this process. The benzol chloride is reduced to benzol, which itself is then no further changed, even by raising the temperature, as the interesting researches of M. Baeyer have already proved.

But even the action of phosphonium iodide on phenol, from which, looking at the experience gathered in the methyl and ethyl series, I was fairly entitled to hope that at least the tertiary and quartary compounds would emerge, gave rise to changes very different from those

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anticipated. The singular phosphorus bodies generated in this reaction claim further examination. New processes, different from those hitherto followed, must therefore be devised for the production of phenylphosphine.

Exactly as in the formation of phenylphosphine, I have hitherto failed in that of phosphoretted zolicidine. On the other hand, the preparation of a phosphorus base corresponding to benzylamine presents no difficulty. Considering that benzyl chloride is easily converted into benzylamine by the action of ammonia (as the researches of Cannizzaro and Limpricht have shown), it could not possibly be doubted that by causing benzyl chloride and phosphonium iodide to meet under appropriate circumstances, an aromatic phosphorus base would be obtained.

Benzylphosphine—

$$C_7H_9P = \left.\begin{matrix} C_7H_7 \\ H \\ H \end{matrix}\right\} P.$$

For the preparation of this body it is not necessary to employ the benzylchloride in its pure state. It suffices to operate with toluol chlorinated whilst hot, which boils between 150° and 180°. The substances to react on one another are employed in the same proportions which, in the methyl and ethyl series, have yielded satisfactory results, viz., 2 mols. of benzylchloride, 2 mols. of phosphonium iodide, and 1 molecule of zinc oxide. A digestion of six hours' duration at 160° is sufficient for the formation of benzylphosphine. When the reaction is finished the digestion-tubes contain a white mass of crystals, which is generally forced out by the phosphoretted hydrogen escaping when the tubes are opened. When the product of the reaction was distilled with the vapour of water, an oily liquid, heavier than water, possessing an extremely characteristic persistent odour, passes over. This was separated from the water by means of a separating funnel, dried by allowing it to stand on caustic potassa, and submitted to fractional distillation in a current of hydrogen. It commenced boiling a few degrees above 100°; the mercury then rose rapidly to 180°, at which temperature a large quantity of a colourless powerfully refractive liquid distilled over. That passing between 180° and 190° was collected apart from the earlier distillate, consisting chiefly of toluol (which is regenerated from the benzylchloride by the phosphonium iodide). The liquid boiling at 180° is benzylphosphine; the residue in the retort contains dibenzylphosphine and other products. Purified by a second distillation in a current of hydrogen, benzylphosphine is found to have the constant boiling-point 180°. In contact with the air the aromatic phosphorus base attracts oxygen with such avidity that the thermometer rises to 100° and more, and thick white clouds are formed.

Benzylphosphine is insoluble in water, but easily so in alcohol and ether. The aromatic phosphorus base shares the characteristic property of the other primary phosphines, viz., that of forming a crystallisable iodhydrate. This is obtained by mixing the phosphine with fuming iodhydric acid, when it falls as a white and apparently amorphous mass. The insolubility of the iodine compound presents an easy method of recovering any benzylphosphine that may have passed over in the first distillate containing toluol. The white precipitate of benzylphosphine iodhydrate dissolves on warming in iodhydric acid, and forms, as the solution cools, white needles, often more than a centimetre long, which, on contact with water, are decomposed into the acid and base. By washing with dry ether and drying in a stream of hydrogen at 100°, the iodhydrate may easily be obtained in a state of purity for analysis. In this experiment, occasionally well-formed tables are produced of considerable dimensions and great beauty. The salt has the composition—

$$C_7H_{12}PI = (C_7H_2)H_2P.HI.$$

Benzylphosphine combines likewise with concentrated chlorhydric and bromhydric acids. I have not, however, been able to obtain these compounds in crystals. The chlorhydrate gives, with platinum chloride, a yellow soluble precipitate.

Benzylphosphine forms, according to the equation—

$$2C_2H_2Cl + 2[H_3P.HI] + ZnO =$$
$$= 2(C_2H_2)H_2P.HI + ZnCl_2 + H_2.$$

This equation, however, shows only one phase of the reaction in which at the same time several other substances are formed.

Dibenzylphosphine—

$$C_{14}H_{15}P = \left.\begin{matrix} C_7H_7 \\ C_7H_7 \\ H \end{matrix}\right\} P.$$

This compound is contained in the liquid remaining in the retort after the distillation of benzylphosphine. By long standing, especially in presence of solid alkali, this liquid solidifies to a soft mass of crystals, which are collected on a linen filter in order to free them, by pressing, as much as possible from adhering liquid. The still strongly-coloured crystals are then dissolved in alcohol and treated with a little animal charcoal. The colourless liquid thus obtained deposits, on cooling, beautiful white crystals of the new compound. By repeated crystallisation from boiling alcohol dibenzylphosphine is obtained in a perfectly pure state. Thus prepared, the phosphine forms large brilliant needles, mostly grouped in stars or glistening tufts, perfectly tasteless and colourless, which are insoluble in water, but dissolve, though sparingly, somewhat in boiling alcohol. In ether they are nearly insoluble. The crystals melt at 205°; at a higher temperature they volatilise, but not without partial decomposition. With the entrance of the second benzyl group, the basic characters, which in the monobenzylphosphine are still perceptible in a marked manner, have entirely disappeared. Dibenzylphosphine dissolves in no acid, nor have I succeeded in obtaining a platinum salt. In this respect the secondary aromatic phosphine essentially differs from the analogous bodies in the ethyl and methyl series, which are distinctly marked bases. This absence of basic properties cannot, however, be looked upon as strange, since even in the secondary aromatic amines the tendency to form saline compounds is very nearly effaced. The difference of dibenzylphosphine from the corresponding terms in the methyl and ethyl series becomes obvious, moreover, in its comportment with oxygen; for whilst dimethyl- and diethyl-phosphine take fire on contact with air at the ordinary temperature, oxygen is without any action even at an elevated temperature on the dibenzylated phosphorus base. As dibenzylphosphine yields no compounds, I was limited to the analysis of the body itself. This analysis led to the formula $C_{14}H_{15}P$. The formation of dibenzylphosphine ensues according to the equation—

$$2C_7H_7Cl + H_3P.HI + ZnO =$$
$$= (C_7H_7)_2HP.HI + ZNCl_2 + H_2O.$$

Benzylphosphine and dibenzylphosphine are not the only phosphoretted products of the action of benzylchloride on phosphonium iodide. The mother-liquor of dibenzylphosphine contains yet another phosphorus body. The thought presented itself that it might be tribenzylphosphine; but notwithstanding many efforts, I have not succeeded in obtaining the compound in a state of purity. The mother-liquor of dibenzyl-phosphine consists, for the greater part, of a viscous substance, soluble in alcohol but insoluble in water, which is precipitated by lead salts. This substance tenaciously adheres to a small quantity of a crystallisable body, which most probably is no other than dibenzylphosphine. All attempts to obtain this glutinous substance (which appears to possess acid properties) in a condition fit for analysis have hitherto failed.

In conclusion I may be allowed most warmly to thank Messrs. F. Hobrecker and E. Niglius for the untiring energy with which they have—the former in the earlier stages, the latter more recently—advanced the progress of these researches.

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ON A RELATION BETWEEN THE SURFACE-TENSION OF LIQUIDS AND THE SUPERSATURATION OF SALINE SOLUTIONS.*

By CHARLES TOMLINSON, F.R.S., and G. VAN DER MENSBRUGGHE.

IT was stated by one of us in Part II.† that when a drop of a liquid is deposited on the surface of a supersaturated saline solution, it will do one of three things:—(1) mingle with the solution without any nuclear action; (2) spread out into a film with powerful nuclear action; or (3) assume the form of a lens, without any separation of salt. It was further stated that when a liquid forms a film or a lens, it does so according to the general proposition, that if a drop of a liquid, B, with the surface-tension b, be placed on the surface of another liquid, A, with the surface-tension a, the drop will spread into a film, if $a>b+c$ (c being the tension of the common surface of the liquids A and B); but if, on the contrary, $a=<b+c$, the drop will remain in the form of a lens. Hence, if B spread on A, A will not spread on the surface of B. When the liquids A and B mingle in all proportions, c has no value. The spreading of the drop may also be interfered with by the superficial viscosity of the solution, or the greater or less difficulty in displacing the superficial molecules.

It was also stated that if a greasy smear be made upon the clean interior surface of a flask above the solution, and the flask be inclined so as to bring a portion of the solution against such smear, the liquid does one of two things:—(1) it breaks up into well-defined globules, which roll over the smear without loss of tension, in which case the smear has no nuclear action; or (2) as soon as the solution reaches the smear its edge flattens and becomes ragged, in which case the smear is nuclear and the salt separates.

A glass rod drawn through the hand becomes covered with a smear or film; or the same rod, by exposure to the air, contracts a film by the condensation of floating vapour, or a deposit of film-forming dust, and so is brought into the nuclear condition.

It was further stated that when a lens of oil is resting on the surface of a solution, the flask may be rapidly rotated or briskly shaken, so as to break up the oil-lens into a multitude of minute globules, giving the solution the appearance of an emulsion; but that by repose the solution regains much of its transparency, without any separation of salt; but that if, while the flask is being turned round, a sudden jerk be given to it, so as to flatten some of the globules against the side, the solution instantly becomes solid.

The powerful action of films in putting an end to the state of supersaturation being thus established, it occurred to one of us, who had already succeeded in explaining a number of obscure phenomena on the principle of surface-tension,‡ that that force, properly handled, would suffice to account for most, if not all, the varied phenomena of supersaturation. According to this view, whatever tends greatly to lower the surface-tension of a supersaturated saline solution, causes a separation of salt, and at once puts an end to the condition of supersaturation.

In order to test this view, a large number of experiments have been performed by one of us, during the last six months, consisting of repetitions of former experiments, or of new ones suggested by one or both of us. All these experiments have been performed in the open air at Highgate, near London, the object being to avoid all possible miscarriage from the effects of floating dust in the air of a room. It had been suggested that some of the former results as to the action of films might have been vitiated from this source; and although this does not appear to have been the case, yet it is with much satisfaction that the experimenter refers to the greater facility and certainty with which experiments of this kind are conducted in the open air, as compared with those made in a room. In the open air a gentle wind would sometimes blow over the mouths of the flasks, sufficient to produce a low musical note, without any nuclear action, unless a speck of soot or a small insect were carried into the solution; but in general, in order to prevent evaporation, the flasks were kept covered with watch-glasses or small beakers, except when performing an experiment.

The salt used in the following experiments was sulphate of soda, in large crystals, not effloresced, one of three strengths being adopted as circumstances required, and which will be indicated when necessary, namely, 1 part of salt to 1 of water, 2 parts of salt to 1 of water, and 3 parts of salt to 1 of water. Every solution was first made in a large flask, and filtered boiling into eight or ten small flasks, which were re-boiled, covered with watch-glasses or beakers, and carried on a tray into the open air. The same experiment was repeated on a number of these solutions of the same strength.

The points to which this experimental inquiry tended are included in the four following propositions:—

I.—That a supersaturated saline solution, contained in a catharised flask, will remain liquid so long as its free surface, or the surface in contact with the sides of the flask, does not undergo in one or many points a notable diminution of surface-tension.

II.—That if we deposit on the surface of a supersaturated saline solution a drop of a liquid of feeble tension, it spreads, and crystallisation takes place immediately, or after a short time.

III.—That while a liquid of feeble tension produces crystallisation after a time more or less short, a liquid of considerable contractile force (such as pure water) not acting chemically on the solution, may be brought into contact with it without producing change of state.

IV.—That as a liquid of feeble tension produces crystallisation, so a solid covered more or less with a film of such liquid, produces change of state, either at once, or after a short time.

But before any conclusions could be drawn from the results of experiments as to the relation between the surface-tension of liquids and the state of supersaturation in saline solutions, it was necessary to measure the surface-tension of the solutions of Glauber's salt operated on. Accordingly the following data were determined, *first*, for a solution containing 1 part of salt to 1 of water, and *secondly*, for a solution containing 2 parts of salt to 1 of water. The diameter of the capillary tube was 1·598 m.m.

Specific gravity of the solution 1 salt to 1 water at 17°C. = 1·198.
The capillary height 11 m.m.
The specific gravity of the other solution = 1·289.
The capillary height 8·7 m.m.

These data give, according to the formula $t=\frac{r.h.d}{2}$ (in which t is the tension, h the height, d the density, and r the radius of the tube), for the superficial tensions of the solutions in question, not a greater value than from 4 to 5·2.

If the state of supersaturation of saline solutions depend on the maintenance of surface-tension, according to the first proposition, any force or substance that produces a notable diminution of such tension will cause the state of supersaturation to cease.

Such a force is heat, while such substances as camphor, benzoic acid, &c., have a marked effect in lowering the superficial tension of water, and in doing so undergo those remarkable gyrations which are so well known.

* A paper read before the Royal Society.
† *Philosophical Transactions* for 1871, p. 52.
‡ "Sur la Tension superficielle des Liquides," par G. Van der Mensbrugghe, Répétiteur à l'Université de Gand. *Mémoires couronnés par l'Acad. Royale de Belgique*, tome xxxiv., 1869. See also *Phil. Mag.* for Dec., 1869, and Jan., 1870.

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And first with respect to heat, applied, not so as to affect the whole solution, but locally so as to raise the temperature at one part or point of the surface, while the other parts remained at the temperature of the atmosphere.

Expt. 1.—Four flasks, each about half full of a supersaturated solution of Glauber's salt (2 salt to 1 water), were exposed to a temperature of 32° F. for an hour. A red-hot poker was then passed down the neck of each flask, and in two of them the hot metal was brought into contact with the surface of the solution so as to raise a volume of vapour. There was no separation of salt in any one case.

Expt. 2.—A solution containing a considerable mass of the seven-atom salt at the bottom of the flask was moved over the flame of a spirit-lamp in a line from the bottom of the flask to the neck, so as to heat one part only of the flask. The only effect was to convert a portion of the surface of the seven-atom salt into the anhydrous; but there was no crystallisation. After some hours the anhydrous portion had again taken up its water of crystallisation.

Expt. 3.—A solution of 2 salt to 1 water that had been in the open air during twenty-four hours was uncovered, and water nearly boiling was dropped upon it. A slight cloudiness came over the solution, but there was no crystallisation. Next day a very weak solution of Glauber's salt nearly boiling was dropped upon the surface with no nuclear action.

Expt. 4.—An eight-ounce globular flask had the globe filled with a solution of 2 salt to 1 water. Solutions of two different strengths, namely 1 salt to 1 water, and 3 salt to 1 water, at a nearly boiling temperature upon it, were dropped, but with no nuclear action.

Expt. 5.—A solution of 1 salt to 1 water had filtered into it a nearly boiling solution of 3 salt to 1 water. The drops descended to the bottom of the flask in beautiful rolling rings, but there was no nuclear action.

Expt. 6.—The neck of a flask was inclined over the flame of a spirit-lamp, so as to boil the upper part of the solution, while the lower part remained cold. Water was driven off in vapour, so as to leave a crust of salt in the neck. This, when the flask was left to itself, gradually absorbed moisture and trickled down, and was also washed down into the solution, but there was no nuclear action either from this or from the heat.

These experiments on the action of heat lead to the conclusion that, however much it may diminish the superficial tension of the solutions, it does not apparently disturb the state of supersaturation. This result may be explained with reference to the feeble tension of the solution (=4), and to the fact that heat locally applied does not greatly diminish it. Moreover, heat tends to oppose crystallisation by increasing the solubility.

Numerous experiments were tried as to the action of newly-sublimed camphor and benzoic acid on the solutions. The flasks containing these bodies floating on the solutions were plugged with cotton-wool and kept for some months, during which time they were repeatedly shaken, but there was no separation of salt. The camphor and benzoic acid formed weak solutions with the supersaturated solutions; but the tension of camphorated water being =4·5, and that of an aqueous solution of benzoic acid falling within the limits 4 and 5·2, the difference in tension is too small to produce a rupture of equilibrium. The same remark applies to a solution of soap and of bicarbonate of soda, which had no nuclear action.

Action of Vapours.—It has been shown by recent researches that the presence of vapours in the air of a room, even in minute quantity, has a marked influence in lowering the tension of water and other liquids, so as to account for the discordant values of various careful measurements of the capillary heights of such liquids. As to the nuclear action of the vapours of certain volatile liquids upon supersaturated saline solutions, many observations had been made by one of us, leading to the conclusion that such vapours are strongly nuclear when they become condensed into the form of films on the surface of the solutions, as when the latter is of a lower temperature than the former. In order to ascertain whether vapours, as such, that is, without forming films, have any nuclear action, the following experiments were contrived. The vapour was presented to the surface of the solution by means of a bit of sponge tied to the end of a glass rod, wetted with the volatile liquid and carefully passed down the neck of each flask, so as to avoid touching the side and bringing the sponge close upon the surface to avoid touching that also.* The sponge was held over the solution several minutes, then carefully withdrawn and the flasks covered, leaving the interior charged with vapour. The liquids used were ether, absolute alcohol, chloroform, bisulphide of carbon, wood-spirit, and benzole. The solutions were of all three strengths, and the temperature from 40° to 47° F. After many hours and even days the flasks had a strong odour of the vapours in question, but there was no separation of salt.

Vapour of camphor was also tried in the following manner:—

Expt. 7.—A quantity of camphor was placed in a small retort, the beak of which, made chemically clean by being heated in the flame of a spirit-lamp, was passed into a flask containing a solution of 2 parts salt to 1 of water. The camphor in the belly of the retort was then boiled so as to produce a powerful jet of vapour upon the surface of the solution. The camphor condensed upon such surface in the form of a fine white powder without any nuclear action.

In this case a portion of the vapour of camphor or of the powder would dissolve in the solution without producing in it a notable diminution of surface-tension. The same remark applies to the other vapours, to the action of solid camphor and benzoic acid, of heat, &c.

So also, as stated in Part II., glycerine mingles with the solution without any nuclear action. Now the surface-tension of glycerine = 4·2, so that it can have no effect in lowering the surface-tension of a solution =4, and does not sufficiently lower the tension of a solution =5·2 to produce a rupture of equilibrium.

It was also stated that bisulphide of carbon $t=3{\cdot}3$ to 3·5, and chloroform = 2·98 to 3·12, formed lenses on the surface of the solution, and that on gently agitating the flask they fell to the bottom, where they remained permanently without any nuclear action. Creosote=3, behaves in the same manner. Now, in any one of these cases, the tension $t+c$ must be greater than 4·5, and hence there can be no separation of the salt.

(To be continued).

ON THE EMPLOYMENT OF BROMINE IN ANALYTICAL CHEMISTRY.

By P. WAAGE.

The oxidising agents, which are principally employed to-day in chemical analysis, are nitric acid, chlorate of potassa and hydrochloric acid, and chlorine. Each of these, however, though excellent in some ways, has drawbacks to its general employment.

Among those prominent in the use of nitric acid, is the slowness with which it acts in dilute solutions; the length of time required, even when concentrated, to oxidise sulphur; that it never can be employed in platinum vessels, on account of small quantities of chlorine, which it generally contains, and that it must never come in contact

* In a few cases the wet sponge did touch the solution for an instant, so as to take up a small portion, which immediately crystallised upon the sponge; but the crystallisation thus produced, not being in contact with the solution, the latter retained its liquid state.

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with organic matter, like filter-paper, if a subsequent precipitation of a metallic oxide is desired.

Chlorate of potassa acts only in the presence of somewhat concentrated hydrochloric acid, which, in larger quantities, may, under certain conditions, affect the accuracy of the work. Considerable difficulty is at the same time experienced in driving out the last traces of chlorine by boiling, especially in working with dilute solutions. Undecomposed chlorate of potassa is generally the cause of this difficulty, and addition of more hydrochloric acid will be necessary, which requires subsequent dilution before filtration.

The limit for the use of chlorine water is a narrow one, as it does not contain more than ½ per cent of chlorine. The employment of gas is troublesome, as an apparatus must be arranged for every oxidation.

Bromine, therefore, seems to me to be the oxidising material which, being free from the drawbacks that prevent the general employment of the three above-mentioned substances, deserves a place in qualitative as well as quantitative analysis.

I employ the bromine principally in three forms,—as free bromine, as bromine-water, and as bromine in concentrated hydrochloric acid. Bromine-water, prepared by shaking an excess of bromine with water, contains between 2 and 3 per cent of bromine. Concentrated hydrochloric acid, treated in the same way, furnishes a solution containing about 13 per cent of bromine. In choosing for each case the oxidising material as to quantity and concentration, an excess may be easily avoided, and the prominent odour and colour of bromine furnish the best means to recognise an excess, which can be driven off easily by boiling, on account of the low boiling-point of bromine. Bromine-water attacks platinum neither in alkaline nor acid solutions, if the latter are free from nitric acid, and it is—in this shape or dissolved in hydrochloric acid—without action on paper, so that a metallic sulphide may be dissolved and oxidised in presence of the filter-paper by means of bromine, when the oxide can be completely precipitated by potassa or ammonia.

I have employed bromine most advantageously for the oxidation of sulphur, sulphydric acid, and metallic sulphides. For two and a half years it has been my solvent for sulphur, magnetic pyrites, copper pyrites, mispickel, nickel mattes, and precipitated sulphides, both for the determination of sulphuric acid and the metals.

Sulphur, shaken with bromine and water, is easily converted into bromohydric and sulphuric acids, if for every atom of sulphur 3 of bromine are present, or 15 by weight of bromine to 1 of sulphur. If sulphur has to be determined in this way, it is best to add all the bromine at once, so that no sulphide of bromine can be formed.

In the treatment of pyrites no necessity will exist for pulverising them very finely, as they are oxidised by bromine quite easily even in larger pieces, but it is best to add water first, and then bromine with constant stirring, that the action may not become too violent.

Bromine-water is the most convenient material for the destruction of hydrosulphuric acid. A few drops of it added to a filtrate from a metallic sulphide will immediately produce a separation of sulphur, which will as quickly be dissolved by a further addition of a few drops of bromine-water.

In dissolving precipitated metallic sulphides I proceed in the following manner:—I perforate the filter-paper, and wash as much of the precipitate as possible into a beaker. I then pour some of the bromine gas into the funnel, and cover the latter with a watch-glass, when after a few minutes the rest of the sulphide may be washed into the same beaker, and a further addition of bromine-water readily oxidises the rest of the sulphide. I thus get rid altogether of the trouble of burning the filter-paper.

Bromine liberates nitrogen in contact with ammonia, and can therefore not be employed as an oxidising agent in an ammoniacal solution. Ammonia may therefore with advantage be used to destroy an excess of bromine. Ammoniacal salts sometimes prevent the development of the oxidising property of bromine, so that the peroxides of cobalt, nickel, and manganese cannot be formed under these conditions; iron, tin, and mercury salts will, however, be easily converted into the higher oxides in acid solutions, though they contain ammoniacal salts.

Bromine, as it usually occurs in commerce, is not pure, but contains a substance which seems to be caoutchouc, from which it must be freed by distillation in an apparatus which does not have any caoutchouc connections.—*Fresenius's Zeitschrift.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 6th, 1872.

In the absence of the President the Chair was taken by Dr. Gilbert, F.R.S., Vice-President.

The minutes of the previous meeting having been read and confirmed, Messrs. J. Vincent Taylor and W. J. Wilson were formally admitted Fellows of the Society. The name of Mr. A. Liversidge was then read for the first time: for the third time—Messrs. George Elliott Barker, H. A. Smith, Richard Hayton Davies, Francis Henry de Rheims, jun., and Richard Weaver, who were then ballotted for and duly elected.

The first paper read by the Secretary was "*On a Remarkable Salt deposited from the Mother-Liquors obtained in the Manufacture of Soda*," by T. E. Thorpe. This salt, which occurs in the highly-concentrated mother-liquors obtained in the manufacture of soda by Leblanc's process, has been shown by Rammelsberg to contain sodium phosphate, and by Baumgarten to contain fluorine, so that it must be regarded as a double salt analogous to fluorapatite. The crystals, which are distinctly octahedral, have a ruby-red colour, caused by some substance irregularly distributed through them: this the author believes to be phosphate of iron. By solution in water and re-crystallisation they were obtained colourless, a small quantity of sulphide and phosphate of iron being separated. An analysis showed that they have the composition $2Na_3PO_4+NaF+19H_2O$, and that they contain traces of vanadic acid.

"*On the Composition of Ceylon Jargons*," by M. H. Cochran. The author has analysed seven specimens of jargon and zircon, from different localities, adopting for this purpose the process employed by Forbes, but in no instance did he obtain indications of the presence of jargonia.

"*On a Double Sulphide of Gold and Silver*," by M. M. Pattison Muir. This compound, which has already been described in our pages, was obtained during some experiments made in New Zealand by Messrs. J. M. Muir and W. Carrick, with the object of separating the silver from the native alloy of gold and silver. Sulphur was passed through the molten alloy, covered with a film of borax, and was by this means raised from 654 to 812 by assay. The comparatively fusible sulphide, which has much the appearance of native sulphide of antimony, is extremely brittle, and has a specific gravity of 8·159. By heating in a current of air it remains undecomposed: hot strong sulphuric acid, however, removes all the silver, leaving metallic gold in a finely divided state. The results of the analysis correspond to the formula $2(Au_2S_3)5(Ag_2S)$.

"*On the Solvent Action of various Saline Solutions upon Lead*," by the same author. From the well-known fact that the presence of certain salts in water greatly diminishes this action on lead, and as lead is largely used for cisterns and water-pipes, the author determined to accurately investigate the effect of various saline solutions upon lead. Pieces of bright lead, having a known area, were therefore suspended in these solutions for various periods of

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time, and the amount of lead dissolved estimated by Wanklyn and Chapman's colour-test. The results are given in a tabular form, from which it would appear that solutions containing nitrates, and especially ammonium nitrate, exert the greatest solvent power, whilst the carbonates have the greatest protecting power, and next to them the sulphates, so that a water containing the latter—even if a considerable amount of nitrates be present—has not a very marked solvent action on lead.

Mr. W. THORPE, in reply to a question from the Chairman, said he had not examined the action of the Loch Katrine water on lead; but as the action of waters on tarnished lead was known to be but small compared with their action on bright lead, the paper just read was merely of theoretical interest, for, practically, potable waters only came in contact with tarnished lead.

"*On the Magnetic Sand of Mount Etna*," by J. B. HANNAY. This sand, which exists in immense quantities on all sides of Mount Etna, has a specific gravity of 2·813, and is scarcely acted on by acids. The results of its analysis gave—Silica, 52·71; magnetic oxide of iron, 19·44; alumina, 19·09; lime, 6·61; and magnesia, 1·85.

"*New Tests for some Organic Fluids*," by J. A. WANKLYN. The author has found that the differential action of potassic hydrate and potassium permanganate may serve as a method to distinguish between various animal fluids. When these are evaporated down with excess of potassa solution, and then maintained for some time at 150°, a certain fixed proportion of ammonia is evolved, and if the residue be now boiled with an alkaline solution of potassium permanganate, a further definite quantity of ammonia is given off, the relative amount of ammonia evolved by these two actions being constant for the same animal fluid. The author has examined, by this method, urine, milk, blood, white of egg, and gelatine, the latter of which gives but a mere trace of ammonia by treatment with caustic potash. The quantitative results are given in a table. It would be possible by this process to distinguish between a spot of milk and one of white of egg on a cambric handkerchief.

"*Dendritic Spots on Paper*," by A. LIVERSIDGE. Minute dendritic marks are frequently noticed on paper, to which various observers have assigned a vegetable origin: the author, however, has distinctly proved them to be inorganic. As it was not possible to obtain a sufficient quantity for complete chemical analysis, a blowpipe examination was made, supplemented by certain special tests. The results showed that the markings consist essentially of sulphide of copper. These dendritic spots have usually a nucleus, which on examination will be found to consist of a minute particle of copper or brass, probably derived from some part of the machinery used in the manufacture of the paper. Other dendritic growths of an organic nature are occasionally found on paper, but they cannot well be mistaken for those described.

Dr. MULLER said he had long ago observed these dendritic marks, and knew them to be caused by portions of bronze detached from the paper-making machinery.

Mr. FRISWELL and Mr. SPILLER said they had both noticed similar dendritic markings on prepared albumenised paper and which were caused by the reduction of silver by metallic particles in the paper.

"*On Chinoline and Leucoline*," by C. GREVILLE WILLIAMS, F.R.S. M. Ballo has recently stated in a paper "On Leucoline Oil and the Pure Napthaline of Commerce" that he obtained a copious precipitate by treating sulphate of leucoline with potassium chromate, and that by the action of amyl iodide, he obtained a violet colouring matter apparently identical with chinoline blue; but the author had always found that, although chinoline forms a crystalline salt of great beauty with chromic acid, pure leucoline gives only a yellow oily precipitate, and, moreover, by the action of amyl iodide, leucoline yields only a faint, dirty purplish colouration, having no resemblance to chinoline blue. The diversity of these results, and also those of Hofmann, would be explained if coal-tar sometimes contained chinoline as well as leucoline. In order to settle this point, the author proposes to make comparative experiments with leucoline obtained from various sources.

A letter was then read by the secretary from Mr. Dewar, of Edinburgh, in which he mentioned that by the oxidation of chinoline he had obtained two new crystalline acids, one of which is mono-carbo-chinolic acid, C_9H_6N,CO_2H. Its potassium salt, when treated with lime, yields pyrrol along with the lower bases, which induces the writer to believe that chinoline is related to pyrrol and indol.

Dr. C. R. A. WRIGHT next read a paper on the "*Action of Phosphoric Acid on Morphine*." This action is somewhat similar to that on codeine, the polymerides being, however, at the same time, converted into "apo" derivatives by the removal of water. The mixed apo bases are immediately precipitated by sodium carbonate from the acid solution, and can in this way be separated from the unaltered morphine. This precipitate contains a small quantity of a base soluble in ether, which appears to be apomorphine, whose formula, according to the author's researches, should be $C_{68}H_{68}N_4O_8$. The portion of the precipitate insoluble in ether, when dissolved in hydrochloric acid, and fractionally precipitated, yields diapotetramorphine $C_{136}H_{148}N_8O_{22}$, which oxidises with great readiness. On dissolving this in strong hydrochloric acid, and evaporating, a tarry residue is obtained soluble in water. Strong hydrochloric acid precipitates from this solution the hydrochloride of a new base, $C_{136}H_{146}Cl_2N_8O_{20}.8HCl$, which differs from chloro-tetramorphine by $-H_4O_4$. Diapo-tetramorphine, when treated with hydriodic acid and phosphorus, yields the corresponding iodine compound $C_{136}H_{146}I_2N_8O_{20}.8HI$. From these results it would appear that the action of phosphoric acid on morphine is analogous to that on codeine, with the difference that the elements of water are abstracted from the products in the first case, but not in the latter. With respect to the physiological action of diapo-tetramorphine, it is quite as energetic an emetic as apomorphine.

A "*Note on a Secondary Colouring Matter Produced in the Preparation of Alizarine from Anthracene*" was then read by the author, W. H. PERKIN, F.R.S., in which he mentioned that he had carefully examined the secondary colouring matter mentioned in his paper on artificial alizarine formerly communicated to the Society. It is soluble difficultly in most liquids, crystallising from glacial acetic acid in minute masses of a yellow colour. Its formula $C_{14}H_8O_5$ is the same as that assigned to purpurine, but it differs from the latter in its reactions; its ethereal solution does not give the characteristic bands of purpurine, and it dissolves in alkalies with a violet colour and not a red. It also differs from alizarine in its reactions, so that it must be considered as quite distinct both from alizarine and purpurine.

"*On the Effects of Temperature on the Absorption of Gases by Charcoal*," by J. HUNTER, M.A. This paper contains an account of the effects of variation of temperature on the amount of ammonia and cyanogen absorbed by cocoa-nut charcoal. In the case of ammonia it would seem that the amount of the gas absorbed by the charcoal continuously decreases as the temperature rises from 0° to 55°, but at that point a sudden change occurs, and the amount of gas given off becomes considerably diminished. In the case of cyanogen the absorption takes place very rapidly, being confined almost entirely to the first ten minutes, and the curve representing the absorption between 0° and 80° is continuous. The results obtained are given in tables, and also represented by absorption curves. Hydrogen and nitrogen are very slightly absorbed by the charcoal.

Dr. ARMSTRONG then read a series of communications from the Laboratory of the London Institution: "*V. On the Nitration Products of the Dibromophenol-sulphonic Acids*;" "*VI. On Bromophenol-sulphonic Acid*;" "*VII. On the Formation of Substituted Nitrophenol-sulphonic Acids*." The experiments described in the first of these

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apers, which have been carried out in conjunction with Ir. F. Brown, are a repetition in the bromo series of hose already made by him in the chloro series, and show hat the products obtained are in every respect analogous o them. Thus, by the action of nitric acid in the cold libromophenol-sulphonic acid, $C_6H_2Br_2OH(SO_3H)$ is converted into *a dibromonitro-phenol*, $C_6H_2Br_2NO_2OH$, melting at 132°, but undergoing decomposition at the same time; a small quantity of *a nitrobromophenol-sulphonic acid*, $C_6H_2BrNO_2OH(SO_3H)$ is simultaneously formed. If the heat evolved during the reaction be allowed to accumulate, however, the product consists mainly of dinitrobromophenol, $C_6H_2(NO_2)_2BrOH$. The latter body is identical with the product of the action of bromine on ordinary dinitrophenol.

In the second communication, Dr. Armstrong describes the preparation of bromophenol-disulphonic acid, $C_6H_2BrOH(SO_3H)_2$, and its conversion by nitric acid into a bromonitrophenol-sulphonic acid—

$$C_6H_2BrNO_2OH(SO_3H),$$

and, by the further action of the acid, into dinitrobromophenol, identical with that obtained from dinitrophenol.

In their third paper, Dr. Armstrong and Mr. F. Brown describe the action of iodine, bromine, and chlorine on an alcoholic solution of nitrophenol-sulphonic acid, $C_6H_3NO_2OH(SO_3H)$. By the action of these elements on an aqueous solution of the acid, a diiodo-, dibromo-, or dichloro-nitrophenol is invariably produced, and it does not appear to be possible to isolate any intermediate product; whereas when an alcoholic solution is employed, the reaction is found to consist in the replacement in the sulpho-acid of *one* of hydrogen by an equivalent of iodine, bromine, &c., giving rise to the formation of iodonitrophenol-sulphonic acid, $C_6H_2INO_2OH(SO_3H)$, &c.

The Secretary read a letter from M. E. Maumené, of Paris, thanking the Society for the interest it had testified in his theory at a previous meeting, and to Dr. E. Divers for the illustrations he had given of it. The writer then criticises the hypotheses of substitution and atomicity, "for which many chemists entertain so strange a predilection—strange indeed, for scarcely a day passes without one of them announcing that he has looked for a particular result indicated by these hypotheses, and found *another*;" and at the same time claims for his theory that it "gives the means of *calculating* true chemical actions *a priori*."

The meeting then adjourned until Thursday, June 20th, when Mr. H. Deacon has promised to give a lecture, "On Deacon's Method of Obtaining Chlorine as Illustrating some Principles of Chemical Dynamics."

CORRESPONDENCE.

QUANTITATIVE ESTIMATION OF COPPER BY MEANS OF CYANIDE OF POTASSIUM.

To the Editor of the Chemical News.

[illegible],—In your journal of the 7th inst., it is stated that L. Yvon asserts that M. de Lafollyé is not the discoverer of the cyanide of potassium process for the quantitative estimation of copper, and quotes a paper published as far back as 1859, by Buignet. It seems singular that there should be any dispute upon this point, as Mr. Parkes, in [illegible] of the numbers of the *Mining Journal* of 1851 announced the discovery, and it has been recognised in England since that time as "Parkes's Process." Some of your readers may recollect that in the first volume of the CHEMICAL NEWS (1860) p. 25, the writer, who had had constant practice in copper assaying, and used the salt in question, gave a full account of its application, and pointed out the metals which did and did not interfere with the desired results.—I am, &c.,

FREDERICK FIELD.

[illegible] Park, Lee, S.E.,
June 10, 1872.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, May 13, 1872.

This number contains the following original papers and memoirs relating to chemistry:—

Dissociation of Carbonic Acid by the Action of an Electric Current.—A. Thenard.—The author states that when a slow current of carbonic acid is passed in Houzeau's apparatus for the preparation of ozone, then that gas is decomposed into oxide of carbon and oxygen, which latter is moreover strongly ozonised.

Influence of Pressure upon the Spectrum Rays.—L. Cailletet.

Observations on the Paper of Personne on the Presence of Selenium in French-made Sulphuric Acid.—M. Lamy.

Presence of Selenium in French-made Sulphuric Acid.—A. Scheurer-Kestner.—The contents of this paper and of that preceding it mainly bear upon a question of priority of research, both authors calling attention to papers and memoirs published by them on this subject some years ago. It appears that selenium and thallium are far more frequently met with in all kinds of pyrites than is generally supposed to be the case, and the slime of sulphuric acid chambers is especially the substance wherein these two elements are to be met with.

Detection and Quantitative Estimation of the Combined Carbon in Meteoric Iron.—J. Boussingault.—The author's researches have been made with a view to ascertain whether meteoric iron contains carbon in the same condition of combination as is the case with steel and manufactured iron. For this purpose the analysis (by means of bichloride of mercury) has been made of the meteoric iron of Caille (Alpes-Maritimes, France) and of Lenarto (Hungary). The former was found to contain 0·12 per cent of combined carbon, but the latter neither contains graphite nor combined carbon.

Researches on the Action of the Opium Alkaloids, viz., Morphine, Codeine, Narceine, Thebaine, Narcotine, Papaverine, Meconine, Opianic Acid.—Dr. Bouchut.—It appears that the large number of opium alkaloids may be divided into two classes, viz., active soporific and inert alkaloids; the first-named differ greatly in their energy of action. It further appears that only morphine and codeine are active alkaloids, and the latter far less so than the former; narceine, when very pure, is a feeble soporific; but papaverine, narcotine, thebaine, meconine, and opianic acid, are—in pure state—inert substances.

Chloral Sulphydrate (Sulphuret of Chloral).—H. Byasson.—By causing sulphuretted hydrogen to act for about 24 hours upon anhydrous chloral, there is produced a new compound,—a white solid body, emitting a very disagreeable smell, and tasting somewhat like hydrate of chloral, soluble in ether, absolute alcohol, chloroform, and crystallising from these solutions. This substance fuses at 77° and boils at 123°; it volatilises like camphor, and its vapours blacken paper impregnated with solutions of lead salts: in contact with water the sulphuret of chloral is slowly decomposed, with deposition of sulphur, evolution of sulphuretted hydrogen, and formation of hydrochloric acid and hydrate of chloral, which remain dissolved in the water; by the action of solutions of hydrated alkalies and ammonia, sulphuret of chloral is very rapidly decomposed, chloroform being formed, and alkaline sulphurets and chloride, as well as formiate of the same base; nitric acid rapidly and very energetically decomposes the body alluded to, the result being the formation of sulphuric and trichloracetic acids; the formula of the sulphuret of chloral is—$C_4HCl_3O_2,2HS$.

Expansion of Moist Gases.—M. Amagat.—The following conclusions can be drawn from the author's researches:—Unless gases are thoroughly well dried, the expansion of the same is increased far less by the presence of aqueous vapour than has been supposed by some *savants*, who have attributed to the presence of aqueous vapour the differences which exist between the coefficients of dilatation of the different gases; that it is absolutely impossible to base a method of hygrometry (estimation of the degree of moisture in air) upon the variation of the coefficient of expansion of the air as due to moisture, since that variation is difficultly appreciable even for very great divergences of the quantity of moisture present in the air.

May 20, 1872.

In addition to several important papers and memoirs relating to geology, mineralogy, astronomy, meteorology, and natural history, this number contains the following paper relating to chemistry:—

Mineralogical Study on Grey-coloured Serpentine.—S. Meunier.—The author has examined ten different samples of serpentine,

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obtained from different countries. It appears that the average composition of this rock in 100 parts is—Silica, 39·90; magnesia, 38·10; alumina, 1·25; lime, 2·0; protoxide of iron, 6·42; water, 11·60. Mineralogically grey-coloured serpentine consists of magnetite, pyroxen, peridote, and magnesite.

Bulletin de la Societe Chimique de Paris, No. 1, January 1, 1872.

From the *procès-verbaux* of the meetings of this Society, we quote the following particulars:—

Preservation of Dilute Hydrocyanic Acid.—M. Petit.—The author finds that the acid diluted to one-tenth deteriorates very rapidly, while an acid diluted to one-thousandth keeps unaltered for several months; and an acid at one-tenth which already exhibits a marked alteration is preserved from further decay on being diluted to one-thousandth: it does not appear that the presence of ammonia provokes the alteration.

An Isomer of Anthraquinon.—Dr. Schutzenberger.—While repeating the experiments of Graebe and Liebermann, the author has discovered an isomer of anthraquinon, a sublimable body, crystalline, beautifully red-coloured, and much resembling alizarine, from which it is distinguished by its insolubility in potassa and ammonia: when the vapour of this substance is heated to 300° it is converted into ordinary anthraquinon.

Phosphorus and Iodoform.—M. Gautier.—When the substances alluded to react upon each other there is formed a yellowish-orange-coloured body, insoluble in almost all solvents, and yielding—when treated with boiling water—first a more bright-coloured compound, and next products of the decomposition of teriodide of phosphorus, which last-named body does not at 250° act upon chloroform.

Action of Sulphuric Acid upon Cellulose.—M. Terreil.—The cellulose is first steeped into a 1 per cent solution of iodide of potassium, and, after drying, is put into concentrated sulphuric acid, and then washed with water, whereby the cellulose becomes blue-coloured. This product does not at all resemble iodide of starch, because, when inspected by the microscope, it will be found to consist of red- and of blue-coloured globules.

This number further contains the following original memoirs and papers:—

Method of Separation of Two Isomeric Toluidines.—Dr. Rosenstiehl.—This lengthy essay is divided into the following sections:—Analytic separation; estimation of toluidine; preparation of pseudotoluidine; method of supersaturation; method based upon the different solubility of the oxalates in water; method based upon fractioned saturation.

Chemical Research on the Crystalline Substance met with on Vanilla.—P. Carles.—After briefly referring to the researches made by other scientific chemists on this substance, and pointing out that the great discrepancies of the results lead to the surmise that the same substance has not always been investigated, the author states that he operated upon the crystals which are usually deposited in the tin canisters in which vanilla is kept. The purified material is an acid termed vanilic acid; it fuses at about 81°, sublimable when heated on platinum foil, very readily soluble in alcohol, ether, chloroform, sulphide of carbon, and in fixed and volatile oils; water at 15° dissolves only 1·2 per cent of this acid, but in boiling water it is readily soluble; mineral acids decompose it, and it yields substitution products with chlorine, bromine, and iodine; vanilic acid colours salts of iron blue, reduces nitrate of silver, and yields an abundant precipitate with acetate of lead. The formula of this acid is $C_{16}H_8O_8$. The author describes, at great length, a number of its salts and some of its substitution products; by fusion with caustic potassa, it yields oxyvanilic acid, $C_{16}H_8O_8$; it is isomeric with anisic, formobenzoylic, methylsalicilic, and a series of other acids.

Production of Cymen by means of the Hydrate of the Oil (Essence) of Turpentine.—P. Barbier.—The hydrate of the oil of turpentine (terpine), $C_{20}H_{16}2H_2O_2$, has been treated with bromine, yielding a thickish liquid—an unstable compound—which, on being acted upon by caustic potassa, is found to consist of a bibromated and tribromated compound, both free from oxygen: by heating these substances cymen is obtained, in all respects akin to the cymen of camphor, viz., a colourless, very fluid liquid, of a lemon-like odour, sp. gr. at 15°=0·864.

No. 2, January 15, 1872.

This number does not contain any original papers or memoirs.

No. 3, February 1, 1872.

New Isopropylic Ethers.—M. Silva.—The formiate is obtained by heating iodide of isopropyl with formiate of copper to 120°: this ether boils at from 65° to 67° under pressure (barometer reading) of 749 m.m. The lactate of mono-isopropylic ether has been prepared by heating—in a sealed tube—to 170°. Lactic acid and isopropylic alcohol:—this ether is soluble in water, and boils at from 166° to 168°; the di-isopropylic lactate is obtained from the former by treatment first with sodium, and next with iodide of isopropyl. The resulting ether is soluble in water, and has a very high boiling-point; the cyanate of isopropyl is a liquid which boils at 74·5°, and has a vapour density of 2·943.

This number further contains the following original papers:—

Ammoniacal Platinum Bases.—P. F. Clève.—The third instalment of a lengthy monograph on this subject, divided into the following sections:—Platinamine—

$$R=Pt''''\begin{cases}NH_2\\NH_2\end{cases}$$

bromide, iodide, basic nitrate, nitrated nitrate (*azotate nitré*), nitrated and chlorated nitrate, bichlorated nitrite, bichlorated nitrite and nitrite of silver, terchlorated nitrite, bromated nitrite, sulphate, basic sulphate, oxalate, and hydrate, of this base. Platino-semidiamine—

$$R=Pt''''\{NH_2.NH_2,$$

chloride, polyiodide, nitrate, chlorated nitrite, bromated nitrite, basic monochlorated nitrite, sulphate, of this base. Platinum monodiamine—

$$R=Pt''''\begin{cases}2NH_2\\NH_2\end{cases}$$

chloride, nitrate, bromated nitrate, basic monobromated nitrate, bromated sulphate, of this base. Diplato-semidiamine—

$$Pt_2''\begin{cases}2NH_2.OH\\2NH_2.OH\end{cases}+H_2O$$

hydrate, chloride, nitrate, sulphate, of this base.

Volumetrical Estimation of Zinc.—A. Hénniger.—The author describes a process of estimating zinc by means of sulphide of sodium, the zinc being in ammoniacal solution. In order to test for the presence of a slight excess of the sulphide, the author recommends, as the most sensitive substance, that kind of so-called enamelled *carte-de-visite* paper which owes its brilliant whiteners to carbonate of lead (white-lead) forced into the pores of the paper by hot-pressing: it is clear that, when operating on zinc ores, the other metals accompanying the zinc have first to be removed.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 8, 1872.

This number contains the following original papers and memoirs:—

Solubility of Sugar in Mixtures of Water and Alcohol, at Different Degrees of Concentration and at Varying Temperatures.—C. Scheibler.—This excellent monograph, elucidated by a series of lengthy tabulated forms, and by a lithographic print exhibiting results of experiments, is not well suited for any useful abstraction.

Action of Permanganate of Potassa upon Tartaric Acid.—A. Fleischer.—After first referring to the researches of Péan de St. Gilles on this subject, the author describes the results of a series of experiments made with and without the addition of a mineral acid to the tartaric acid solution to which a permanganate solution is added. It was found that, when no mineral acid is added, there is formed a certain amount of a tartrate of protoxide of manganese—

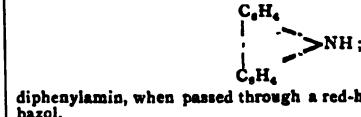
$$C_4H_4MnO_6.2H_2O.$$

This salt is soluble in tartaric and mineral acids, insoluble in alcohol oxalic acid solution, treated in a similar manner with permanganate, yields oxalate of protoxide of manganese; citric acid, when treated with permanganate solution only, is also partly decomposed, but no salt akin to those just alluded to is formed.

Communications from the Chemical Laboratory of the University at Freiburg, in Breisgau (Baden).—A. Claus.—This paper is divided into the following sections, the contents of which, notwithstanding their high scientific value, are not well suited for any useful abstraction:—On dichlorhydrin; on dichlorglycid; on carbothialdin; on the preparation of azobenzol; on azophenylen, a new nitrogen compound belonging to the aromatic series.

On Nitro-naphthalins.—A. A. de Aguiar.—This essay, illustrated by woodcuts exhibiting crystallographical figures, treats at length on the nitro-compounds of naphthalin, viz., mononitro-naphthalin, best prepared by dissolving the naphthalin in very highly concentrated glacial acetic acid, and treating this solution with strong nitric acid, ebullition being resorted to for a few moments; it depends upon the degree of concentration of the nitric acid, and upon the duration of time of its action upon the naphthalin solution, what nitro-compound will be formed; the mononitro-naphthalin is a sulphur-yellow-coloured, prismatically-crystallised body, soluble in alcohol, better still in glacial acetic acid, fusing at 61°, formula $C_{10}H_7(NO_2)$; of dinitro-naphthalin, an α and β compound are distinguished, the formula of each is the same, viz., α and β $C_{10}H_6(NO_2)_2$,—α dinitro-naphthalin fuses at 216°, the β compound at 170°; of trinitro-naphthalin, also an α and β compound are distinguished, formula α and β $C_{10}H_5(NO_2)_3$,—the α compound fuses at 122°, the β at 218°; of tetranitro-naphthalin, likewise an α and β compound are distinguished, the formula for these being—α and β $C_{10}H_4(NO_2)_4$,—the α body melts at 259°, the β at 200°.

Synthesis of Carbazol.—C. Graebe.—After first referring to the communication made by Braun and Greiff (Chemical News, vol. xxv., p. 191), the author states that he obtained carbazol from aniline, by slowly passing that fluid through a very highly-ignited porcelain tube; there are formed by this operation large quantities of hydrogen and ammonia, while cyanide of ammonium is also produced. Carbazol is in this instance produced according to the following formula:—$2C_6H_7N=C_{12}H_9N+H_2+NH_3$. The author states that carbazol is to be viewed as imidodiphenyl, formula—



diphenylamin, when passed through a red-hot tube, also yields carbazol.

Preliminary Communications.—I. Remsen.—The author states that (1) by the reaction of V. Meyer (not further explained), parasulphobenzoic acid is converted into perfectly pure terephthalic acid; (2), when paratoluol sulphamide is oxidised with bichromate of potassa and

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sulphuric acid, it is converted into an acid, which contains the group SO_2NH_2; this new acid is parasulphamin benzoic acid—

$$C_6H_4\begin{cases}SO_2NH_2\\COOH.\end{cases}$$

Products of Iodisation (Iodirung) of the Isomeric Acids $C_7H_6O_2$.—MM. Hlasiwetz and Weselsky.—After first referring to some researches made by the authors some three years ago, relating to the substitution of the hydrogen of phenol by iodine, the authors now state that they have tried this process with great success on the three isomers of the formula $C_7H_6O_2$, whereby it was found, however, that in some cases all—in others only a portion—of the hydrogen was eliminated, this difference being due to the different position occupied by the hydrogen atoms in the organic molecule.

Contribution to the History of the Isocyanuric Acid.—A. Steiner.—Notwithstanding its high scientific value, the contents of this essay are not well suited for any useful abstraction, an observation which also applies to the following memoir.

Determination of the Constitution of Alcohol Radicals by the Oxidation of Aromatic Hydrocarbons.—A. Popoff and T. Zincke.

No. 9, 1872.

This number contains the following original papers and memoirs:—

Nitro-Compounds of the Fatty Series.—V. Meyer and O. Stüber.—The first instalment of a monograph on this subject. This portion is divided into the following sections:—On nitro-ethan; action of iodide of ethyl upon nitrate of silver; action of iron and acetic acid upon nitro-ethan; action of alkalies on nitro-ethan.

Application of Sulphuretted Hydrogen as a Reagent in Researches and Tests made on the Dry Way.—J. Landauer.—The author describes at some length the results of some experiments which led to the discovery that, when a metallic compound is mixed with some pulverised hyposulphite of soda, and then heated upon a bead of borax in the inner blowpipe-flame, then the peculiarly characteristic reactions sulphuretted hydrogen exhibits with metallic solutions are readily brought out. This paper is illustrated with a diagram exhibiting the names of a large number of metallic oxides, their behaviour with $Na_2S_2O_3$ and with a borax bead alone in the oxidising and reduction flames.

Preliminary Observation on the Ready Evolution (Abspaltung) of Hydrocyanic Acid from Nitro- and Dinitro-Benzol and Similar Compounds.—J. Post and H. Hübner.—The authors, after alluding to an observation made as far back as the year 1828 by Dr. Wöhler (*Pogg. Ann.*, xiii., 488), viz., that picric acid yields, by treatment with baryta water, hydrocyanic acid, state that they recently found that even dinitrobenzol, when boiled with caustic soda or potassa solution, becomes decomposed, hydrocyanic acid being evolved, which the authors converted into cyanide of silver and ferrocyanide of iron (*alias* prussian blue). The dinitrobenzol operated upon was perfectly pure; the alkali was prepared from sodium, and, as regards potassa, specially tested for its perfect purity. Mononitrobenzol yields hydrocyanic acid when fused with caustic alkali, and picric acid does the same when boiled with a solution of that substance.

Pentahydrated Sodium-Metasilicate, $Na_2OSiO_2 + 5H_2O$.—T. Petersen.—While visiting a chemical factory, the author obtained from the manager a crystalline substance which had been separated from the mother-liquor of a crude caustic soda lye. The crystals are large-sized, colourless, transparent at first, but become turbid by exposure to air; they fuse readily in their water of crystallisation. After ignition a white bulky mass is left, which is readily soluble again in water. This substance consists, in 100 parts, of—Silica, 28·30; soda, 29·25; water, 42·45. To this paper is added a crystallographical description, illustrated with woodcuts.

Estimation of Uric Acid.—E. Salkowski.—This paper contains a rectification of Schwanert's assertion that the author's (Salkowski) researches on this subject are incorrect, the last-named author pointing out that Schwanert has not read his more extensive memoir published on this subject.

Some Molecular Combinations of Phosphorus-Bromochloride and Bromine.—A. Michaelis.—Notwithstanding the high intrinsic merits of this lengthy memoir, its contents are not well suited for useful abstraction.

Sulpho-Acids of Aniline Blue.—C. Bulk.—This exhaustive monograph is divided into the following sections:—Triphenyl-rosaniline-monosulpho acid, $C_{20}H_{16}(C_6H_5)_2(C_6H_4SO_3H)N_3 + H_2O$; triphenyl-rosaniline-disulpho acid; triphenyl-rosaniline-trisulpho acid; triphenyl-rosaniline-tetrasulpho acid; sulpho acids of aniline violet; sulpho acids of ethyl-phenyl-rosaniline.

Researches on the Constitution of the Benzol-Derivatives.—V. von Richter.—The third instalment of an exhaustive memoir on this subject. The author deduces the following classification of the benzol-derivatives from his researches:—

Chinon.	Dinitrobenzol.	Volatile nitrophenol.
Oxybenzoic acid.	Salicylic acid.	Paraoxybenzoic acid.
Phthalic acid (1,2)	Isophthalic acid. (1,3)	Terephthalic acid. (1,4)

Composition of Two Varieties of Crystallised Cast-Iron.—Dr. C. Rammelsberg.—In one of the samples the iron alluded to was derived from a broken rail-rolling cylinder at the Henrichs Works, near Hattingen-on-the-Ruhr (Rhenish Prussia). This iron was crystalline, exhibiting regular octahedrical crystals, sp. gr., 7·285. Electro-negative compounds present in the following quantities, per cent:—Graphite, 1·121; carbon, 1·963; silicium, 1·537; sulphur, 0·113; phosphorus, 0·041. The atomistic relation of these elements to that of the iron is as 1 : 7·6. Sample of iron from the Friesenbruch Works (Nova Scotia), metal also crystalline, sp. gr. 7·617:—Quantity of graphite, a trace; quantity of the following elements, per cent—carbon, 2·820; silicium, 0·334; phosphorus, 0·086; sulphur, 0·000; C, Si, P : Fe = 1 : 7 and P : Si : C = 1 : 4·3 : 84; Si : C = 1 : 19·5.

La Revue Scientifique de la France et de l'Etranger, May 18, 1872.

This number contains a very exhaustive review of Dr. Berthelot's recently published work:—

Organic Chemistry.—E. Alglave.—This extensive memoir is too concisely written to admit of any useful abstraction, but it appears that the work alluded to, "Traité de Elémentaire de Chimie Organique," is in every respect a standard work that deserves the attention of all scientific chemists.

May 25, 1872.

This number does not contain any original papers relating to chemistry.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, April 4, 1872.

Description of a Newly-devised Arrangement of Retorts for the Distillation of Bituminous Shales..—M. De Jussieu.—From what is here stated it appears that the arrangement described effects a considerable saving of fuel for heating, while, moreover, the retorts do not require renewal for a very long period of time.

Pulverised Bricks in Lieu of Hydraulic Cement.—C. Mène.—The author states that in Cuba, and other Spanish colonies, there is used, in lieu of hydraulic cement, a mixture, consisting of 1 part of pulverised bricks, 1 part of lime, and 2 parts of sand. These ingredients are well blended together in a dry state, and then made up as mortar is, with water.

Description of a Contrivance for Hermetically Closing Doors so as to prevent Draughts of Air.—M. Challiès.—This description is illustrated by a series of woodcuts. It appears that this contrivance is used with great success in Paris, to prevent draughts of cold air entering rooms, houses, workshops, &c, through the chinks of the doors.

MEETINGS FOR THE WEEK.

MONDAY, June 17th.—Anthropological, 8.
TUESDAY, 18th.—Zoological, 9.
WEDNESDAY, 19th.—Meteorological, 7. (Anniversary).
—— Geological, 8.
THURSDAY, 20th.—Royal, 8.30.
—— Royal Society Club, 6.
—— Zoological, 4.
—— Chemical, 8. Mr. H. Deacon, "On Deacon's Method of obtaining Chlorine as Illustrating some Principles of Chemical Dynamics."

TO CORRESPONDENTS.

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A. P. S.—Consult work by Dr. Duflos. See "Notes and Queries" column, vol. xxiv., p. 313. See also "Reviews of Works," by same author, vol. xxiii., pp. 81 and 224.

G. P.—Reimann's "Aniline and its Derivatives," edited by W. Crookes, F.R.S., was published some time since by Longmans. Another work on Dyeing will appear in the autumn.

J. M.—The paraffin received was not good. Get a specimen from a respectable operative chemist.

F. M. R.—Papers by Mr. Stanford and others have frequently appeared in our columns. Consult the Index.

E. W. Prevost.—The No. was sent from our office.

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THE CHEMICAL NEWS.

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THE FARADAY LECTURE,

DELIVERED BY

PROFESSOR CANNIZZARO

BEFORE THE

MEMBERS OF THE CHEMICAL SOCIETY OF LONDON, MAY 30, 1872.*

THE meeting was held in the Lecture Theatre of the Royal Institution, kindly lent for that purpose; DR. FRANKLAND, F.R.S., the President of the Society, occupying the Chair.

Dr. FRANKLAND, in introducing Professor CANNIZZARO, explained that the lectureship had been founded by the Chemical Society in honour of the illustrious Faraday, to be held by some eminent foreign *savant*, who, during the term of his tenure, was to deliver a discourse before the Society. In 1869 M. Dumas had honoured them with his presence there, and on that night they were to listen to Professor Cannizzaro, of Palermo, who had undertaken to deliver the Faraday lecture. After alluding to the numerous investigations which the Professor had made in organic chemistry, and amongst others the discovery of benzylic alcohol,—the first normal aromatic alcohol that had ever been prepared,—and to the important theoretical views which he had originated, the President, in the name of the Society, presented to him the Faraday medal struck in honour of his visit.

Professor CANNIZZARO said, that when he received the flattering invitation to deliver the Faraday lecture he was placed in very unfavourable circumstances to respond to it, as he had no definite results from recent researches to lay before the Society, and was, moreover, on the point of suspending his labours, and abandoning his old laboratory, in order to remove to Rome and establish a new one there. In this difficulty a subject for a discourse fortunately presented itself, and which the celebrated French chemist Dumas, had promised to treat of in 1847,—namely, the form which the theory of chemistry should take at the present time. Although this could not be fully discussed in such a short space of time, it would at least have the advantage of directing the attention of chemists to a question of great importance in the transition stage which our science is at present going through.

In recalling the promise which M. Dumas had made to the Academy of Sciences of Paris, in 1847, to examine the form which theoreticai instruction in chemistry should take in the present state of the science, the lecturer proposed to consider in his discourse the limits within which the exposition of general theories should be included in teaching chemistry, and the form that it was desirable that it should assume.

Whilst giving a broad sketch of the progress of modern chemistry, he showed that the atomic theory had become more and more intimately interlaced with the fabric of chemistry, so that it is no longer possible to separate them without rending the tissue, as it were, of the science, and that up to the present time we have been unable to enunciate even the empirical laws of chemical proportion independently of that theory; for those who employ the term "equivalent" in the sense that Wollaston did, commit an anachronism. Consequently, in the exposition of the value and use of symbols, formulæ, and chemical equations, not only are we unable to do without the atomic and molecular theory, but it is even inconvenient to follow the long and fatiguing path of induction which leads up to it. By one of those bold flights of the human mind we can at once reach the height whence we discern, at a glance, the relations between facts.

He then went on to show that the solid basis, the corner-stone of the modern molecular and atomic theory, —the crown of the edifice of which Dalton laid the foundation,—is the theory of Avogadro and Ampère, Kœnig and Clausius, on the constitution of perfect gases, to which chemists, unknown to themselves, have been led in the progress of their science. He thought the time had arrived for reversing the order which had hitherto been followed in teaching chemistry; that instead of setting out from the criteria for determining the weight of the molecules, and then to show their ratio to the vapour densities, they ought, on the contrary, to commence with the latter, with the theory of Avogadro and Clausius, demonstrating it from physical considerations; to found upon that the proof of the divisibility of simple bodies, that is to say, the existence of atoms; and to show, as occasion presented itself, that the weights of the molecules, and the numbers of the atoms deduced by the application of this theory, are in accordance with those which are deduced from chemical criteria. By this means we can measure the degree of confidence to be placed in the latter criteria, since so-called compound equivalents do not suffice to determine the weight of molecules, or even to prove their existence. They may, however, be deduced from a single principle—the theory of the constitution of gases: this is the natural transition from physics to chemistry.

The Professor then stated, in detail, how he applied the principles he had laid before them. He introduced his pupils to the study of chemistry, in endeavouring to place them on the same level as the contemporaries of Lavoisier, and to teach them to appreciate the importance of the principle of the conservation of the weight of matter, showing them that this is quite independent of any idea of its nature or constitution. They are thus led to examine the ponderable composition of substances, so that the student passes rapidly from the epoch of Lavoisier to that of Proust, and then to that of Berzelius at the time when he commenced his researches on proportions. At this stage the same impulse is given to the pupil as Berzelius received on becoming acquainted with the hypothesis of Dalton. The latter is laid before him without any accessory, the use of symbols and formulæ being introduced dogmatically. There will now arise in his mind the same doubts and difficulties that assailed Berthollet, Sir Humphrey Davy, and Wollaston, in the application of Dalton's theory, and, at the same time, a desire for an explanation of the simple relation which exists between the vapour-volumes of bodies which react on one another, and of the products which are obtained. Now is the moment to state or recall to mind the physical theory on the constitution of the perfect gases, commencing with a rapid glance at their general and special characters. He insisted that in this part of the instruction the mind of the student should not be diverted from the numbers expressing their relations, by any considerations of the variations caused by changes of temperature and pressure. In applying the theory of the constitution of gases, it will be perceived that the molecules of simple bodies are not always the atoms of Dalton, and a certain confusion will thus be produced in the mind of the beginner in the conception of the ideas of atoms and molecules. The hypothesis of Dalton can now be laid aside, substituting, as a starting-point, the theory of the relation of molecular weights to the vapour densities. A table must be prepared of the vapour densities compared with that of hydrogen as 2, that is to say, the weights of their molecules compared with the weight of the semi-molecule of hydrogen taken as unity. We must then compare the composition of the molecules containing the same element,—including, or not, the molecule of the element itself,—and thence deduce the law of the existence

* Abstract.

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of atoms, that is to say, the amount of each element which always enters, by whole multiples, into the molecules which contain them. We here have the atoms of Dalton, which, in the present state of the science, express not only all that Dalton discovered, but also the composition of equal volumes of their vapours, and in the choice of which those doubts can no longer arise which embarrassed Davy and Wollaston. The ideas of molecules and atoms suggested to the student by this law are devoid of all considerations of form, size, continuity, or discontinuity; the only property indissolubly connected with them is that of ponderability—the very definition of matter.

Recollecting that no physical theory of the constitution of matter had yet been advanced which thoroughly conformed to chemical ideas, he insisted upon the advisability, in teaching the molecular and atomic theory, to keep it free from all that is not absolutely essential, so that it may preserve sufficient plasticity to adapt itself to the progress of our physical and mathematical knowledge. For this purpose he thought it useful to allow the student, in the first place, to glance at the changes in the hypothesis of the constitution of matter, and then to cause him to estimate the degree of confidence it merits in the actual state of our knowledge. Having thus placed upon a solid basis the fundamental notions of atoms and molecules, by the comparison of the composition of equal volumes of the bodies in the gaseous state, it becomes necessary to consider the difficulties which arise in the application of these notions when the vapour densities are wanting: he explained and justified the use of the various auxiliary criteria to which we have recourse in these cases, proving them, in the first instance, by the touchstone of the theory of Avogadro and Clausius, by showing that they gave results in accordance with that theory whenever the two methods can be employed simultaneously.

He believed that we should never lose sight of the starting-point, nor give the formulæ of all compounds as of equal probability. "It is not by concealing the obscurity of these questions that we shall enlighten the student; on the contrary, we should estimate each fact at its true value, by showing him that our science does not merit an equal degree of confidence on all points." This forms the introduction, the preparation for the study of the transformations which matter undergoes—the real object and aim of our science.

The comparison of the atomic composition of molecules has led chemists to the law of substitution, to the theory of types of Dumas, then to that of Williamson and Gerhardt, and, lastly, to the theory of the different valency of atoms and their modes of union, or the so-called theory of atomicity which includes the former. Although at present it is impossible, in teaching chemistry, entirely to eliminate this latter theory, which gives a summary of several laws, and guides us ordinarily in the co-ordination—and even prevision—of a large number of facts, yet it is difficult to keep it within just bounds, so as to avoid infusing into the mind of the beginner illusions which are dangerous for their intellectual education. In order to avoid this, it is advisable to bear in mind the progress of this doctrine, and the actual phase of development which it has at present reached. It is still far from being a complete and well-established theory, but is in a state of transition, for although, doubtless, it embraces a large number of facts, as yet it does not embrace them all. It is only a partial representation of the reality, and that from a restricted point of view, showing but little relation to our views of the constitution of matter, for it is the result of a comparison of diverse facts expressed by means of the atomic and molecular theory. It is convenient, therefore, to consider each part of this doctrine exclusively in relation to the group of facts which has suggested it.

It is unadvisable to define the valency of atoms as a property inherent in them, and then to deduce as a corollary their different modes of union; on the contrary, it is preferable to regard each portion of this doctrine as a deduction from the observation and comparison of a determinate group of facts, until an opportunity offers to unite these fragments into one whole, not forgetting, however, to notice the gaps which exist,—never going beyond what the facts themselves suggest, and never applying to all bodies indiscriminately the laws which suit only a single group. For instance, we must not pass over in silence the fact, that whilst certain elements are bi-, tetra-, or even hexa-valent, others are tri- and penta-valent; but the pupil should be prevented from acquiring mechanical and geometrical ideas of the cause and effects of the valency of atoms, by frequently reminding him that chemical facts show nothing about the size, form, continuity, or relative position of atoms. If we are sometimes obliged to employ the expression, "relative position of atoms in the molecules," and even to represent them graphically, we must warn the student that these are only artifices to express certain transformations, and that we are really ignorant of the relative position of the atoms, either in space or in the mutual action of different portions of matter. With these reservations it is possible, in teaching, to derive considerable advantage from the theory of atomicity, and at the same time avoid its inconveniences.

In the study of the transformations which matter undergoes, we should direct the pupil's attention not only to the ponderable changes in the composition of molecules, but also to the electrical and calorific phenomena which accompany these transformations. Even from Lavoisier's time, it has been recognised that we cannot separate the study of matter from thermic considerations, and every day the connection which exists between chemical and thermic phenomena becomes more apparent.

As in the study of ponderable changes we were guided by the law of the conservation of weight, so in the connection between chemical and dynamical phenomena, we are guided by the law of the conservation of force, the two studies mutually supplementing and illustrating one another. Not only will the atomic and molecular theory and that of atomicity help us to compare dynamical phenomena, but the study of dynamical phenomena will show us analogies and differences between chemical actions which would not be observed in the ponderable equations. We should, therefore, instruct the student in the little definite knowledge which we at present possess concerning thermic and electric phenomena, and especially fix in his mind the fundamental notion of a mechanical equivalent, and the manner of comparing it with chemical action as expressed by the atomic theory. In this we should be aided by the previous or simultaneous instruction of the student in physics under the form and language of the thermo-dynamic theory.

The lecturer concluded by observing that in the choice of methods and of matter for a course of chemistry, it should always be borne in mind that it was eminently a progressive science, and that, even at the time of its most rapid development. The student should start not only with a knowledge of certain definite and fixed principles, but with an aptitude, and sufficient preparation to enable him to follow the science in its unceasing transformation and progress, whether he intends to expressly cultivate chemistry, or has only learnt the elements of the science as an auxiliary to other studies or professions. Moreover, the end of chemical instruction for both these classes of students is not only to fix in their memory a certain amount of knowledge, but to assist in their intellectual education. For this, chemistry, of all sciences, is one of the best, offering, both in verbal and practical instruction, excellent occasions for the exercise and harmonious development of all the faculties of the human mind.

He had desired to call attention to what he considered to be the most efficient means of imparting a knowledge of chemistry, so that it might serve as an instrument of

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intellectual education, and that the student, by following it in its ulterior developments, might judiciously apply it to the study of the other branches of natural science. If the attention of the eminent chemists and professors there present were once attracted to this subject, he felt certain that a bright light would be thrown on it, and that our young professors would find numerous suggestions to direct them in teaching chemistry, and that at the very moment when instruction in our science had become so difficult on account of the rapid transformation which it was undergoing.

Dr. WILLIAMSON said that those who were present ought not to separate without some expression of the pleasure that they had felt in listening to so learned, vast, and eloquent a discourse, treating as it did of a most difficult and important problem. There was scarcely anything of greater moment in the scientific education of youth than the rightly setting before them those wonderful transformations of matter which it is the province of chemistry to explain. These great and growing truths,—for, as the lecturer had said, they were growing truths,—should be set before youth in such a manner as to form a coherent whole. He hoped to study this masterly discourse with profit and delight, and would now propose a vote of thanks to his illustrious colleague for the honour which he had done them in delivering to them the Faraday lecture.

Professor TYNDALL said he had heard the discourse with deep interest, for it showed that the lecturer knew the importance of a teacher's vocation, and that his province was not merely to communicate knowledge, but to do it in such a manner as to arouse an interest in, and love of, the subject in the pupil by preserving it in its proper relations. He would have welcomed the lecturer to that Institution even had he come to tear in pieces the notions which he cherished regarding atoms and molecules; how pleasant it was, then, to find such a broad agreement between their views. The chemist cannot halt at equivalent proportions: he *must* ask himself whence they arise, and the inevitable answer is some form of the atomic theory. This theory, however, cannot be confined to chemical phenomena: the motions of those atoms and molecules underlie all our explanations of the physical cause of light and heat, and they are already taking up the field of magnetism and electricity. Consider, for example, the heat of gases, both as regards the motion of translation of the molecules which produce temperature, and the motions of rotation and vibration of their constituent atoms, which, though they do not express themselves as temperature, constitute a portion of the heat. Clausius has shown that, even in the simplest gases, nearly two-fifths of the whole heat is due to these internal motions; whilst in gases of complex molecular constitution, which condense on combining, the ratio of the total heat to the heat of temperature is still greater. The experiments of Regnault, which show that the specific heat of a perfect gas at a constant volume is constant, proves, as Clausius has shown, that the one kind of motion is proportional to the others. The lecturer had also referred to atoms of the same kind combining together, so that free oxygen and free hydrogen, being considered as composed of molecules each containing a pair of atoms, has certainly simplified the results. But it must not be forgotten that this combination of like atoms is generally different from that of unlike atoms. The union of oxygen with oxygen, or nitrogen with nitrogen, produces no such effects upon the luminiferous ether as the union of oxygen with nitrogen. With the same quantity of matter, the amount of *vis viva* sent forth as radiant heat may be augmented a thousand-fold, perhaps a million-fold, by the act of diverse combination. This act seems to carry with it a condensation of the ether to a dense atmosphere around the atoms. Had a cannon the power of gathering round itself a dense atmosphere, it would send forth a greater amount of *vis viva* as sound. A gun fired at Chamouni may be heard upon Mont Blanc, while the same gun fired on Mont Blanc may not be heard at Chamouni, because the air in which the concussion takes place is denser in the one case than in the other. In the same way, the diverse atoms, vibrating in the denser atmosphere formed on combination, show their vast superiority as radiators over like atoms, which, except in such special cases as ozone, &c., are incompetent to produce a similar condensation. The speaker then asked them to echo the resolution so well put to the meeting by Professor Williamson.

ELECTRO-CAPILLARY ACTIONS.

IN a recent note on this subject to the Paris Académie des Sciences, M. Becquerel writes as follows:—

Electro-capillary actions depend on a principle which is of frequent application in organic and inorganic nature; they appear wherever two liquids, which are conductors of electricity and have an affinity for each other, are separated by a partition of capillary structure which the liquids enter in virtue of capillarity. The liquids then react on each other, and cause an electric current along the thin liquid layer adhering to the sides of the capillary passages, which acts like a solid conductor.

In order to constant intensity this must be constantly depolarised; and this condition is fulfilled when the elements deposited by electro-chemical action are removed by the meeting liquids.

This is an electro-capillary couple, and by means of it most metals may be reduced and other substances deoxidised. The metallic solution is placed in a cracked tube closed at the end, and this is plunged in a solution of monosulphuret of sodium. Two thick glass plates bound together may be used to hold the metallic solution.

The following experiment proves the conductive power of the sides of the crack when covered with liquid. If a concentrated solution of protoxide of lead in caustic potash be substituted for the solution of monosulphuret of sodium, this does not effect the reduction of the copper, the electromotive force being less than in the other case. But if an electric current from a nitric acid couple is caused to pass into the two solutions by two plates—one of copper, connected with the positive pole, and placed in the solution of nitrate of copper; the other of platinum, connected with the negative, and placed in the solution of plumbic potash—there is, shortly after, metallic copper deposited on that part of the crack in contact with the metallic solution, and on the opposite part peroxide of lead. The metallic solution is thus decomposed; the nitric acid has combined with the alkali, and the oxygen has peroxidised the lead. The current then becomes constant. The effect is the same as if a platinum wire were introduced to connect the two solutions, and the electric current passed by it only from the one to the other, the end of it in the metallic solution being the negative pole, the other the positive; and we may infer that the sides of the crack act in the same way as metallic electrodes. Before the deposit, oxygen and hydrogen are disengaged, one within, the other without the tube, and this must proceed from the decomposition of water. The disengagement increases with the deposition of the copper, as this deposit acts the part of conductor. Instead of a cracked tube, a tube closed at the lower end with parchment may be used, giving the same results.

The surface of a body covered with a thin layer of a liquid conductor of electricity adhering to it through capillarity, conducts like solid substances, though in a less degree. In a cracked tube, the internal and external surfaces, being only prolongations of the sides of the crack, ought to show the same physical properties as these; only that the sides of the crack being nearer the centres of chemical action, contribute more to the electro-chemical effect. The following experiment leaves no doubt as to this:—

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The tube and vessel of the electro-capillary apparatus having been filled with water acidulated to 1-10th with sulphuric acid, and the air expelled by boiling, a platinum plate was put in each, and these plates were connected with the poles of several couples. The water was decomposed; and if the positive plate was in the liquid of the tube, small bubbles of oxygen formed on it and on the internal surface of the tube. We must therefore conclude that the glass surface acted as a positive electrode.

The electro-capillary couples already referred to are of a simple kind. We may increase the effect in the following way:—

We have seen that, when two solutions, one acid, the other alkaline, act on each other in a capillary space, that part of the capillary space in contact with the metallic solution is the negative pole, and the other the positive pole of the couple. The decomposing force of the current may be increased by aid of another current resulting from a similar chemical action. Communication is established between the two liquids by means of a curved tube (not capillary) containing a thick wick of asbestos, moistened previously with distilled water. The liquids rise on either side of the tube, meet, and react on each other; electricity is disengaged; the metallic solution sets free the positive electricity, the alkaline solution the negative, and the circuit is closed by the crack. Thus a current arises in the same direction as the electro-capillary current of the crack, and the force is increased. If the crack did not exist, or if the opening were not capillary, the two currents resulting from chemical action would destroy each other, going in opposite directions. The increase in force is in proportion to the diameter of the communicating tube.

This subject connects itself with the passage of blood in the arteries and veins, and the transformation of arterial into venous blood. In a previous memoir it was shown that the electro-capillary effects were produced in cracks of 0·030, 0·029, and 0·05 m.m. breadth, and the phenomena of hæmatosis take place in capillary tubes of similar diameter. As to the effects produced on contact of arterial and venous blood, we may suppose that the cause is, as in the phenomena we have been considering, electro-capillary. The sanguineous electro-capillary couple is constant, like the inorganic one: an indispensable condition of hæmatosis. This constancy arises from the fact that the electro-capillary current constantly removes from the arterial blood the oxygen contained in it, carrying it to the internal sides of the venous capillary tubes (which are positive), where it burns the carbonaceous matters and others which penetrate by infiltration.

It is not possible to verify the electro-capillary theory in a living being: and the conditions change after death; but the analogy of effects induces us to admit that of the causes.

EXAMINATION OF THE GASES OCCLUDED IN METEORIC IRON FROM AUGUSTA CO., VIRGINIA.

By J. W. MALLET, Ph.D., M.D.,
Professor of Analytical and Applied Chemistry, University of Virginia.*

THE investigation by Graham of the gases given off by meteoric iron from Lenarto, in Hungary, when heated in a vacuum produced by a Sprengel-pump, excited much interest at the time of publication,† but does not seem to have been followed up by any similar examination of other meteorites. I have made use of pieces of the iron found about three years ago in Augusta Co., Virginia, the description and analysis of which were published by me in the *American Journal of Science* for July, 1871, in order to repeat the experiment of Graham and ascertain whether similar results to his would be obtained. A large part of the work of the extraction and analysis of the gaseous contents of this iron has been done by two of the students in my laboratory,—Mr. F. P. Dunnington, of Baltimore, and Mr. J. B. Adger, of South Carolina,—to whom I am much indebted for their assistance.

Two preliminary experiments were made; the first with some shavings from the cutting of the iron upon a planing-machine; the second with a solid piece of the metal planed to smooth, clean surfaces, and quite free from any crust or scale. The shavings were subjected to the purification practised by Graham, namely, washing with a hot solution of potassic hydrate, followed by washing with distilled water and thorough drying. The solid strip of iron was not so treated, care having been taken to use no oil upon the tool employed in cutting it. Both specimens gave off gas readily when heated in the Sprengel vacuum, the amount in each case being larger in proportion to the bulk of the iron than in the experiment of Graham; and analysis showed that the same gases were present as those found by him, with the addition of carbonic anhydride in not inconsiderable amount.

The final experiment was made as follows, with great care, and with all precautions which could be thought of to avoid error.

A parallelopiped of iron was cut upon a planing-machine, from the largest of the three masses found (that spoken of as No. 1 * in the paper above referred to), the work being done with special care, to avoid the least trace of grease being derived from the machine.

Not only was the cutting-tool itself made red-hot in the blacksmith's fire, hardened in clean water, and tempered and ground without contact with anything greasy, but every part of the machine-bed, set-screws, and frame, from which any risk was to be feared, was carefully cleansed, and paper used to cover the whole of the iron, except where actually borne upon by the tool. The piece of iron measured about 75 m.m. long, 16 m.m. wide, and 12 m.m. thick. It was cut from as solid a portion of the mass as could be found, and was quite bright upon the surface and free from crust, though traces of a very minute crack or fissure were barely perceptible at one end. The piece weighed 124·589 grms.; and as the specific gravity of the iron had been found to be 7·853, the volume was 15·87 c.c. A new and perfectly clean porcelain tube, with sound glaze, was used, heated by a small upright fire-clay furnace with good draught, through holes in the opposite sides of which the tube was passed. The fuel was charcoal, in pieces a little larger than a walnut. The Sprengel's pump had a fall-tube of about 1·34 metres long; its connections were made with great care, and were protected by outer casings of india-rubber tube, with the annular space between the tubes filled with glycerine. A plate of glass, floating on the mercury in the funnel at top, served to prevent the risk of air being carried down, as the metal was gently poured on through another and smaller funnel with narrow aperture.

A good vacuum having been obtained in the cold, lighted charcoal was placed in the furnace, and gas very soon began to come off.

It was determined to analyse separately that collected at the beginning, middle, and end of the process, in order to see whether the different constituent gases were given

* A paper read before the Royal Society.
† Read before the Royal Society, May 16, 1867.

* The results of ordinary analysis were.—

Iron	88·706
Nickel	10·163
Cobalt	0·396
Copper	0·003
Tin	0·02
Manganese	trace
Phosphorus	0·341
Sulphur	0·019
Chlorine	0·003
Carbon	0·172
Silica	0·067
	99·872

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off at the same or at different rates. The total amount obtained was 36·33 c.c., reduced to 0° C., and 1 metre pressure. This was divided into three portions, for analysis, as follows:—

		h. m.
A.	52·02 per cent of the whole was collected in	2 30
B.	24·11 " " "	2 20
C.	23·87 " " "	9 40
	100·00	14 30

It will be seen that the greater part came off within the first two hours and a half; but the process lasted *fourteen hours and a half*, and was not entirely over at the end even of this time. The heat had been gradually raised from dull redness to something nearly approaching whiteness at the end of the time; and when the experiment was stopped, very small but still perceptible traces of gas were still coming off, though their appearance was immediately arrested whenever the temperature was allowed to fall but a little below the high point which had been reached.

The piece of iron taken out from the tube when it had become quite cold was found glazed by a thin film of fused phosphide of iron and nickel (Schreibersite), thickest on the edge which had been lowest, this phosphide having oozed out from the mass at the very high temperature used.

The tubes used to collect the gas during the first portion of the time occupied in the experiment were found slightly moistened on the inside, and the moisture, which had a distinctly acid reaction, was proved to contain hydrochloric acid, this having no doubt been derived from the chlorine existing in the iron in combination with that metal and with nickel.

Careful analysis of the gas yielded the following results by volume for the three portions separately collected: the fourth column of figures, obtained by summing up the three which precede it, gives the percentage composition of the whole of the gaseous matter extracted from the iron:—

	Portion A.	Portion B.	Portion C.	Total gas.
Hydrogen	22·12	10·52	3·19	35·83
Carbonic oxide ..	15·99	11·12	11·22	38·33
Carbonic anhydride	7·85	1·02	0·88	9·75
Nitrogen	6·06	1·45	8·58	16·09
	52·02	24·11	23·87	100·00

Other gases were tested for, but none could be found; no free oxygen could be detected, nor any compound of carbon and hydrogen.

From these figures it appears that hydrogen maintains about the same proportion to the other gases in A and B, but diminishes largely in C; that carbonic oxide increases in amount in B as compared with A, but remains about the same in relative amount in C; that carbonic anhydride diminishes throughout the whole continuance of the experiment; and that nitrogen falls off in B as compared with A, but largely increases again in C.

Contrasting the results with those of Graham, and noticing first the total volume of gas obtained from the iron, it becomes necessary to reduce this volume to the same standards of pressure and temperature employed by him. In the paper read before the Royal Society, as reported in its "Proceedings," I find no statement in regard to such standards; but, supposing it probable that the barometer at 30 inches and thermometer at 60° F. were referred to, I have calculated the volume of gas obtained in all from 15·87 c.c. of iron as equivalent under these conditions of pressure and temperature to 50·40 c.c., or 3·17 times the volume of the metal. This is a somewhat larger quantity than that of Graham, namely, 2·85 times the volume of the Lenarto iron used; but the time of heating was longer in the experiment now described, and the temperature attained probably much higher.

As to the nature and relative amount of the constituent gases, the results differ very noticeably from those of Graham, as is evident when the figures of the two analyses are placed side by side.

	Lenarto Iron.	Augusta Co., Virginia Iron.
Hydrogen	85·68	35·83
Carbonic oxide	4·46	38·33
Carbonic anhydride ..	—	9·75
Nitrogen	9·86	16·09
	100·00	100·00

The gases obtained in the experiment now in question agree more nearly with those of common wrought-iron (clean horse-shoe nails) as found by Graham,* viz., in the first portion collected—

Hydrogen	35·0
Carbonic oxide	50·3
Carbonic anhydride	7·7
Nitrogen	7·0
	100·0

and the conclusion arrived at by him, that "the predominance of carbonic oxide in its occluded gases appears to attest the telluric origin of iron," would deny to the Virginia specimen the right to be classed amongst meteoric masses, with which, however, all its other physical and chemical characteristics agree most fully.

It is to be noted that the analysis of the gases from the Lenarto iron was not made with the whole of the gaseous matter collected: the first portion, amounting to about 32·5 per cent of all collected, was used for merely qualitative examination; the second portion, 57·6 per cent, was that fully analysed; while no mention is made of the disposition of the remaining third portion of 9·9 per cent; and it is stated that the iron was not fully exhausted at the end of 2 hours and 35 minutes, for which time only the experiment was continued. In my own experiment it appears probable that the amount of hydrogen (and with it the total volume of gas) has been slightly diminished by its union with chlorine of metallic chlorides, to form the minute quantity of hydrochloric acid observed in the faint film of moisture on the sides of the first tubes; and probably also this moisture itself may have been caused by the partial reduction, by means of hydrogen, of carbonic anhydride to carbonic oxide. Although it might be assumed, especially in view of the strong tendency of iron to take up and "occlude" carbonic oxide, that this gas had been the original form in which the gaseous carbon compounds obtained existed in the iron, and that it had in part broken up at the temperature of the experiment into carbon, remaining united with the iron, and carbonic anhydride which escaped as gas,—yet, in view of the steady decrease in the quantity of this latter gas collected as the experiment proceeded and the temperature became higher, and bearing in mind the ready decomposition it undergoes in contact with ignited iron, it seems more likely that a larger amount of carbon originally existed in the iron in this higher state of oxidation than appears from the figures of the analysis. Although the proportion of hydrogen found is so much less in the Virginia than in the Lenarto iron, it yet represents for the former about 1·14 times the volume of the iron itself, whereas common terrestrial iron occludes but about 0·42 to 0·46 of its own volume under ordinary pressure.

I am quite satisfied, from the condition of the masses of iron as they came into my hands, and especially from the character of the crust, that the metal has not been subjected to any heating in a blacksmith's fire or otherwise by human hands since it was found, as has sometimes happened to similar specimens in the endeavour to discover their nature, or to make use of them.

Whether or not this analysis be considered as furnishing

* *Loc. cit.*

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presumptive evidence of the Virginia iron having come to our earth from a different atmosphere to that of which the Lenarto meteorite brought us a sample,* the result differs so far from that of our sole previously-recorded determination of the kind as to make it a matter of much interest that a larger number of meteoric irons, from various localities, should be subjected to careful examination in the same direction, thus supplementing our knowledge of the fixed constituents of these curious bodies by a study of their gaseous contents.

ON THE

ACTION OF DILUTE SALINE SOLUTIONS UPON LEAD.†

By M. M. PATTISON MUIR, F.C.S.

IT has been long known that water, which has been kept for some time in leaden cisterns, dissolves and holds in solution a certain amount of the lead forming the cistern. Pure rain or distilled water, it has been remarked, does this to a very notable extent, and in some waters—especially those containing nitrates—the amount of Pb thus dissolved is very considerable. Waters containing nitrates, and even pure waters, have thus exerted a poisonous influence on persons drinking them, such effects being in many cases clearly traceable to the lead held in solution by these waters. On the other hand, notice has been taken of the fact that the presence—even to a very minute extent—of certain salts in the water, especially sulphates and carbonates, tends to diminish the solvent action of that water upon lead; and hence, before using very pure waters, it has been customary in some places to add certain quantities of soluble carbonates and sulphates, in order that these may act as a check to the solvent action of the water upon the leaden pipes through which it may have to pass. It seemed that a somewhat more definite statement than is generally found in the text-books, as to the amounts of Pb dissolved in a given time by waters containing various salts in solution, might not be devoid of interest or of practical use. As the water supplying so many towns traverses—for longer or shorter distances—leaden pipes, and as even very small quantities of lead held in solution by a water largely used for domestic purposes must through time exert a hurtful effect upon those using it, to determine actually how much lead is dissolved by a water of definite composition, and how much of some foreign substance must be added to stop this solvent action, appears a not unimportant problem; nor would I pass over the value which any reduction of a chemical action to definite figures must necessarily and intrinsically possess.

At the suggestion of Prof. Thorpe I have undertaken some measurements of this action of water on lead, the results of which I shall now state.

500 c.c. of distilled water were poured into a clean flask, and, after a number of such flasks were thus filled, there was then added to each weighed quantities of various salts. Pieces of clean bright lead were then suspended by threads in these solutions, so that the liquid should have free access to all parts of the Pb; thus the surface of Pb acted on could be accurately determined. In these experiments, the surface acted on was = 5600 sq. m.m. The flasks were then set aside for 24, 48, and 72 hours, at the expiration of each of which periods the amount of Pb dissolved was estimated. To do this I employed a slight modification of the method given by Wanklyn and Chapman, in their book on "Water Analysis." This process is essentially a colorimetrical one, the amount of Pb present being estimated by the depth of colour given to the solution, on the addition of H_2S, as compared with the colour given to an equal bulk of pure distilled water, to which is added a known quantity of a standard Pb solution.

The standard Pb solution employed contained 0·1 grm. Pb per lit. of H_2O, so that each c.c. corresponded to 0·0001 = $\frac{1}{10}$ m.grm. of Pb. 100 c.c. of the solution to be tested were employed, and the reaction was of sufficient delicacy to detect easily 2 parts of Pb in 1,000,000 parts of water.

As to the composition of the solutions whose action has been tested, I have, in the first place, examined the action of Pb on solutions containing a determinate amount of only one salt in solution; then I have sought to answer the question—How would the addition of another salt act? would it retard or hasten the solvent action of the water on the Pb? If it retard this action, which salts, and how much of these, exercise such an influence to the most notable extent? If it hasten the solvent action, which salts do so in the greatest degree? Further, I have tried the action of a mixture of more than two salts in solution, thus approaching more nearly the conditions of an actual water. The results are embodied in the following table, in which the amounts of salts in solution in the water and the amounts of Pb dissolved are stated both in grms. per lit. and grs. per gall.:—

Salt.	Grms. per lit.	Grs. per gal.	Pb Dissolved. m.grm. per lit.			Pb. Dissolved grs. per gal.		
			24	48	72	24	48	72
NH_4NO_3	0·020	1·4	13·0	—	25·0	0·91	—	1·750
"	0·040	2·8	15·0	15·0	32·0	1·05	1·05	2·240
"	0·080	5·6	15·0	—	—	1·05	—	—
KNO_3	0·020	1·4	2·0	2·0	—	0·14	0·14	—
Na_2SO_4	0·050	3·5						
KNO_3	0·040	2·8	0·8	1·0	1·2	0·05	0·07	0·080
Na_2SO_4	0·212	14·7						
KNO_3	0·045	3·1	—	—	0·3	—	—	0·021
K_2CO_3	0·308	21·5						
KNO_3	0·070	5·4	—	—	0·5	—	—	0·035
K_2SO_4	0·504	35·2						
$CaSO_4$	0·252	17·5	0·4	—	0·8	0·02	—	0·050
"	0·408	28·5	0·4	—	1·0	0·02	—	0·070
K_2CO_3	0·310	21·7	—	—	0·2	—	—	0·014
"	0·516	36·1	—	—	0·2	—	—	0·014
$CaCl_2$	0·250	17·5	0·5	0·5	0·5	0·04	0·04	0·040
"	0·510	35·7	0·3	—	0·4	0·02	—	0·028
Na_2SO_4	0·200	14·0	—	—	0·8	—	—	0·050
"	0·400	28·0	—	—	0·5	—	—	0·030
NH_4NO_3	0·020	1·4	—	—	1·8	—	—	0·126
$CaCl_2$	0·060	4·2						
NH_4NO_3	0·020	1·4						
K_2CO_3	0·100	7·0	—	—	0·4	—	—	0·028
Na_2SO_4	0·200	14·0						
Na_2SO_4	0·200	14·0						
K_2CO_3	0·040	2·8	—	—	0·1	—	—	0·007
$CaCl_2$	0·100	7·0						
Loch Katrine..			1·0	1·0	1·5	0·07	0·07	0·105
Distilled			2·0	2·0	3·0	0·15	0·15	0·210

The amounts of Pb dissolved in the same period of time, by waters containing different salts in solution, are thus seen to be very varied. Of all the salts whose influence upon the solvent action of pure water on lead was tested, nitrates—especially ammonium nitrate—increase that solvent action most largely. Perhaps the actual amount of nitrates generally present in water is not quite so great as that which I have experimented with, yet I would call attention to the fact that water containing the smallest quantity, viz., 0·02 grm. per lit., dissolved almost as much Pb as that containing double as much NH_4NO_3. Again, it should be noted that generally as much, or almost as much, Pb was dissolved after 24 hours' action as after 72 hours; so that, in keeping a water in leaden cisterns for domestic purposes, although this water may never remain long in contact with the Pb, yet doubtless it would—if a water containing nitrates—dissolve in a short time hurtful amounts of that metal. The action of chlorides, at least of the only chloride with which I have

* Some of the observations of Secchi and Huggins seem to render it probable that carbon may play an important part in some regions of the universe, though the results on this head are not as full or satisfactory as those in reference to hydrogen.

† Read before the Glasgow Philosophical Society.

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experimented ($CaCl_2$), seems to be a retarding, not a hastening action, as regards the amount of Pb dissolved: this has been noticed, both in the case of a water containing—as compared with distilled water—only chlorides, and also a water containing both chlorides and nitrates. Of those salts which have been experimented with, it is seen that the carbonates exercise a retarding action to the greatest extent; thus a water containing 0·31 grm. of K_2CO_3 per lit., = 21 grs. per gall., dissolves, after 72 hours' action on clean, bright lead, only about $\frac{1}{10}$th of a gr. per gall. of water; or, in other words, the presence of 1 part K_2CO_3 in 3000 parts H_2O almost completely prevents such a water from exercising any solvent action on Pb. The soluble sulphates also exercise a very important retarding action, nearly as great—although not quite so—as that of the carbonates. If a water containing nitrates, even amounting to 0·02 grm. per lit., an unusually large amount, contain at the same time sulphates, as small a quantity as 0·05 grm. per lit., the solvent action of such a water on Pb. is thereby very much diminished,—diminished in the proportion of 13 to 2. The same deterrent action is exhibited by carbonates, with 0·045 grm. KNO_3 and 0·308 grm. K_2CO_3; the amount of Pb dissolved, proportionately to that made soluble by a water containing the same amount of KNO_3, but without any carbonates, was as 16 is to 0·3. The carbonates are thus even more beneficial than the sulphates, in the case of waters containing nitrates, and, as I before remarked, also in waters free from nitrates. When nitrates, carbonates, and sulphates are present together in a water, then the solvent action of this water on lead is almost *nil*. This is also the case if the sulphates or carbonates be replaced by chlorides, although in the latter there is a slightly greater action than in the former instance: thus, if to a water containing 0·02 grm. NH_4NO_3 per lit. be added double as much (0·06 grm.) $CaCl_2$ per lit., then the amount of Pb dissolved by this water is exceedingly small—about 1¼ m.m. per lit. in 72 hours. This action is one of some importance, as, generally speaking, water containing nitrates contains also chlorides, both perhaps coming from the same or similar sources.

From all these experiments I conclude that although we may, on analysis, detect a pretty large amount of nitrates, yet we must not hastily condemn such a water,—as far as its action on lead is concerned, I mean,—but must carefully determine whether there be not also such amounts of other salts—as chlorides, sulphates, or carbonates—present as shall, to a great measure, neutralise the hurtful action of the nitrates. Unfortunately we do not, as yet, possess reliable information as to the amount of lead which is positively hurtful to the vital economy; but we may perhaps say that a water containing 1 gr. per gall, would not generally be looked on with favour. That Loch Katrine water actually does exercise a solvent action on Pb cannot be doubted.

In my experiments, the amount dissolved by ordinary water, taken from the Laboratory tap, was 1 m.m. per lit. = $\frac{7}{10}$ gr. per gall, after 24 hours action of the water on a clean, bright piece of Pb. In 48 hours the amount of Pb in solution had not increased, and after a lapse of 72 hours the increase only amounted to about $\frac{8}{10}$ gr. per gall. As our cisterns are generally very far from being bright and clean, and as, after the first few hours, the solvent action diminishes very notably, we may conclude, I think, that the actual amount of Pb taken into the system along with the water we drink is not considerable. Does this amount of Pb thus gradually deposited in the system slowly find its way out again, or does it remain accumulating all through life? Does this in any way influence the general health of our bodies? May the healthiness of some places be influenced materially by the amount of Pb dissolved by the water in constant use? These are questions yet remaining to be answered—questions which are to be solved more by the physiologist than by the chemist.

ON OPTICAL PHENOMENA PRODUCED BY CRYSTALS SUBMITTED TO CIRCULARLY POLARISED LIGHT.*

By WILLIAM SPOTTISWOODE, LLD., M.A.,
Treasurer R.S. and R.I.

ON a former occasion I exhibited some phenomena depending upon circular, or, as it was then also called, successive, polarisation, and in particular I adopted and explained a method for producing circularly polarised light devised by Sir Charles Wheatstone. I propose, on the present occasion, to pursue the subject into some of its ulterior consequences. In terms of the wave theory, light is said to be circularly polarised when the vibrations are circular, as distinguished from plane polarisation, when they are rectilinear. And further, it is known from mechanical principles that a circular vibration may always be produced by the combination of two rectilinear vibrations, the amplitudes or extents of which are equal, and whereof one is advance or in rear of the other by one or by any odd number of quarter-wave lengths. In the former of these cases the circular motion will take place in one direction, say right-handed; in the latter in the opposite, say left-handed. The contrivance I will now use for producing circular polarisation is known by the name of a "quarter-undulation plate," and consists of a plate of mica split to such a thickness that one of the two rays into which plane polarised light is divided on entering it is retarded by an odd number of quarter-wave lengths behind the other.

The optical phenomena produced by crystals, when submitted to polarised light, are usually divided into two classes, viz. (1), those arising from the use of parallel light, and consisting of broad sheets of colour; and (2), those due to convergent light, and consisting of the rings and brushes, the general character of which is well known. I propose to take a few specimens from each class, and to examine the modifications which the known phenomena undergo when the light is both polarised and analysed circularly, *i. e.*, when one quarter-undulation plate is interposed between the polariser (Nicol's prism) and the crystal to be examined, and the second between the crystal and the analyser (Nicol's prism).

In the first place, it is known that if a plate of selenite be placed in an ordinary apparatus when the polariser and analyser are either parallel or crossed, there are four positions, at 90° apart, in which the plate will produce colour; and further, that if the analyser be turned through 90° the same result will be obtained, except that the colour will be complementary to that first seen. The intensity of the light at any given point is then given by the formula—

$$\cos.^2 s - \sin. 2i \sin. 2 (i - s \sin.^2 \frac{\theta}{2},$$

where i and s are the angles made with the original plane of polarisation by the principal sections of the crystal and of the analyser respectively, and θ is the retardation.

If, however, the two quarter-undulation plates (say the plates A and B) be introduced, the light undergoes the following processes:—First, it is plane polarised by the polariser; secondly, the plate A being placed so that its axis is inclined at $\pm 45^c$ to the original plane of polarisation, the light undergoes right- or left-handed circular polarisation, and in that condition falls upon the crystal; thirdly, in their passage through the crystal C the rays are each divided into two, whose vibrations are at right angles to one another, and whereof one is retarded in proportion to the thickness of C; fourthly, the plate B being placed so that its axis is parallel or perpendicular

* Read before the Royal Institution of Great Britain.

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to that of A, each of these sets of rays is circularly polarised, one set right-handed and the other left-handed; fifthly, these two oppositely circularly polarised sets of rays combine, according to known mechanical laws, on emerging from B, into plane rays, in which the planes of polarisation, of the different colours of the spectrum are turned through different angles. Hence, finally, by turning the analyser round we shall cross these various planes in turn, and successively extinguish the different colours, leaving the complementary colours visible. The system of plates A C B consequently acts in this respect like quartz. It is, however, to be observed, that if the plate B be turned from one of the two proposed positions to the other, the directions of motion in the two emergent circularly polarised rays, and consequently the planes of polarisation of the different colours, will be reversed; in other words, with the plate B in one position we shall imitate a right-handed, with the plate B in the other a left-handed, quartz. The intensity of the light at any point is then given by the formula—

$$\sin^2 \frac{\theta}{2} \text{ for one position,}$$

$$\cos.^2 \frac{\theta}{2} \text{ for the other.}$$

Again, if—the plates A B retaining either of the positions before indicated—the crystal C be turned round in its own plane, then, since the light emerging from A and B is circularly polarised, it has lost all trace of direction with reference to the positions of the polariser and analyser, and consequently no change of tint will be observed. The same is abundantly clear from the formula written above, because the only term it contains depends upon the retardation within the crystal C. This experiment was made by Airy.

If the plates A and B have their axes directed 45° on either side of the axis of C, and the three plates be turned round as one piece, the colour will remain unchanged; while, if the analyser be turned, we have the colours shown in the regular order. If the plates A and B have their axes directed at 45° on the same side of the axis of C, and the pieces be turned round bodily as before, the colours change in the same order as above, and go through their cycle once in every 90° of rotation; and if the analyser be turned in the same direction, the colours change, but in the reverse order. The explanation of this is to be found in the fact that, when the plates A and B are crossed, the retardation due by A is compensated by that due to B; so that the only effective retardation is that due to the crystal C. But upon this depends the rotation of the plane of polarisation: if, therefore, the polariser and analyser remain fixed, the colour will remain unaltered. When the plates A and B have their axes parallel there is no compensation, and the colour will consequently change. This experiment was made by Fresnel.

The mathematical expressions for the intensity of the light in the two cases respectively are—

$$\cos.^2\left(j+i+\frac{\theta}{2}\right), \text{ and } \cos^2\left(j-i-\frac{\theta}{2}\right),$$

where i is the angle made by the principal sections of A with that of the polariser, and j that of the principal section of B with that of the analyser. The first expression is obviously unchanged when the angle between the polariser and analyser, viz.—

$$\frac{\pi}{2}+i+j,$$

is unchanged. It should be added that the rotation of the plane of polarisation, and consequently also the sequence of tints, does not follow exactly the same law in the above cases as in quartz.

We now come to the case of convergent light, that is, to the phenomena of crystal rings. And let us examine the effects produced by the same argument as before, via x.. two quarter-undulation plates, A, B, one in front and one behind the crystal C. To quote from Mr. Airy:—"The first thing that strikes us in this combination is that there is nothing, except in the crystal, that has any respect to sides. For the only incident light is circularly polarised; the only light allowed to emerge is circularly polarised. The appearance therefore of the coloured rings, &c., must be such as conveys no trace of any plane of polarisation, and must not vary as the crystal is turned round. In the common exhibition of the coloured rings the principal trace of the planes of polarisation is in the uncoloured brushes. In uniaxal crystals they form an eight-rayed star, composed of two square crosses, inclined at an angle equal to that between the planes of polarisation, every ray of which separates complementary rings. In biaxal crystals they compose two pairs of rectangular hyperbolas, the angle between whose asymptotes is the same as that between the planes of polarisation, and whose branches divide complementary rings. The two crosses, or two sets of hyperbolas, unite when the planes of polarisation are parallel or perpendicular. But in the case under consideration the rings exhibited by crystals will not be traversed by any brushes. Uniaxal crystals will exhibit circular rings without a cross; and biaxal crystals will exhibit complete lemniscates, without any interruption from curved brushes." And it is further to be noticed, as the formula given above indicates, that the centres of the rings will be bright or dark according as the analyser stands at 0° or 90°.

To pursue this matter further. Suppose that, the arrangements remaining otherwise as before, the analyser be turned round; then in any position intermediate to 0° and 90° the rings will be contracted and extended in opposite quadrants, until at 45° they are divided by two diagonals, on each side of which the colours are complementary. Beyond 45° the rings begin to coalesce, until at 90° the four quadrants coincide again. During this movement the centre has changed from bright to dark. If the motion of the analyser be reversed, the quadrants which before contracted now expand, and *vice versa*. Again, if the crystal (say positive) be replaced by another (say negative), the effect on the quadrants of the rings will be reversed. This method of examination therefore affords a test of the character, positive or negative, of a crystal.

A similar process applies to biaxal crystals; but in this case the diagonals interrupting the rings are replaced by a pair of rectangular hyperbolas, on either side of which the rings expand or contract, and the effect is reversed either by reversing the motion of the analyser, or by replacing a positive by a negative crystal, or *vice versa*. The experiment may then be made in biaxal crystals, by turning the analyser slightly to the right or to the left, and observing whether the rings advance towards, or recede from, one another in the centre of the field. In particular, if polariser and analyser being parallel, the plate A have its axis in a N.E. direction to a person looking through the analyser, the plate B its axis in a N.W. direction, and the crystal be so placed that the line joining the optic axes be N.S., then, on turning the analyser to the right, the rings will advance to one another if the crystal be negative, and recede if it be positive. The mathematical expression for the intensity of the light at any point P is in this case—

$$\tfrac{1}{2}(1 + \sin. 2j \cos. \theta + \sin. 2b \cos. 2j \sin. \theta),$$

where b is the angle between the principal section of C through P and the principal section of B, and j the angle between the principal sections of B and the analyser. This shows that when the polariser and analyser are parallel or crossed at 0° or 90°, and consequently $j = 45°$ or 135°, the expression is independent of b, *i.e.*, the intensity is the same throughout circles about the centre,

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but that when the polariser and analyser are crossed we have an expression of the form—

$$\tfrac{1}{2}(1 \pm \sin. 2b \sin. \theta),$$

the sign of the second term depending upon the direction in which the analyser has been turned, and also upon the sign of θ, that is, upon the character (positive or negative) of the crystal.

The dispersion of the planes of polarisation, effected by the passage of plane polarised light through a plate of quartz cut perpendicular to the axis, may be rendered visible by interposing such a plate of quartz between the polariser and a uniaxal or biaxal crystal, when the analyser is at 90°, *i. e.*, when dark brushes are formed. In this case the brushes cease to be black, and are tinged throughout with colour. The analyser must, however, be turned back or forward, according as the quartz be right-handed or left-handed, in order that it may cross in succession the planes of polarisation of the different coloured rays, and so produce the most vivid effects. The dispersion of the brushes by a plate of quartz may, however, be studied, by employing an additional polariser and quartz plate between the source of light and the whole system previously used. By turning this polariser round we extinguish each ray of the spectrum in turn, and tint the whole field with the complementary colour. The brushes will then appear to revolve about their centres as the tints vary continuously from one end of the spectrum to the other. If the polariser be turned still farther round, the tints which had changed continuously from red to violet, or *vice versa*, change suddenly from violet to red, or *vice versa*, and the brushes jump suddenly back to their original position.

This last optical arrangement may be employed to examine the more important phenomena of the dispersion of the optic axes produced, not by a quartz plate between the usual polariser and crystal, but by certain biaxal crystals themselves.

ON A RELATION BETWEEN THE SURFACE-TENSION OF LIQUIDS AND THE SUPERSATURATION OF SALINE SOLUTIONS.*

By CHARLES TOMLINSON, F.R.S., and G. VAN DER MENSBRUGGHE.

(Concluded from p. 282.)

We now pass on to consider the second proposition, namely, that if on the surface of a supersaturated saline solution there be deposited a drop of a liquid of feeble tension, the drop spreads and crystallisation is determined. Now it is shown in Part II. that drops of ether, of alcohol, and of similar volatile liquids, as well as of certain oils, both volatile and fixed, spread over the surface of the solutions and act as powerful nuclei. On the surface-tension theory, a liquid such as ether, of which the tension = 1·88, or alcohol = 2·5, or wood-naphtha = 2·11, or oil of lavender = 2·9, must spread on the surface of a supersaturated solution of Glauber's salt, of which the surface-tension is as high as from 4 to 5·2. This is true in a large number of cases that have been observed, and so far the phenomena are consistent with the theory. But there are cases in which liquids of low tension, such as oil of turpentine = 2·2 to 2·4, and some varieties of castor-oil = 2·5, do not form films, but well-shaped lenses, and remain as such during many hours and even days. Quincke seems to have met with cases of this sort in his elaborate inquiry on the capillary phenomena of the common surface of two liquids,† and he endeavours to account for these exceptions to the general law, by the statement that if a lens-shaped drop of a liquid 2 (of low tension) remain on the free surface of a liquid 1 (of much higher tension) without spreading itself out, then it is certain that in most, and probable that in all cases the free surface of liquid 1 is rendered impure by a thin layer of a foreign liquid 3. Now in experiments on supersaturated saline solutions, the flasks, the filtering apparatus, and the solutions must be, as already explained by one of us, chemically clean, so that in boiling and filtering a solution into clean flasks in which it is boiled up again, covered over and left to cool in the open air of the country, it is difficult to imagine the existence of such a film as M. Quincke refers to. Moreover, did such a film exist, the solution in cooling would probably become solid under its action. Indeed, this sometimes happens in the case of flasks that have been already used in experiments on the nuclear action of oils; for, however carefully they are cleansed, it may happen that one or two out of a dozen may not be quite clean, so that, in the cooling of a boiling solution, a film detached from the walls of the flask may spread over the surface with nuclear action. In order, if possible, to prevent the formation of such a film, the following experiment was made:—

Expt. 8.—A solution of 1 part of Glauber's salt to 1 of water, with the addition of a bit of caustic potash, was boiled and filtered into four clean flasks. When cold, a drop of castor-oil was deposited upon the surface of each of the solutions. It flattened at first, but soon recovered the lenticular form. There was no nuclear action during an hour. On gently shaking the flasks, the oil was diffused through the solution without nuclear action.

In an experiment described in Part II. fragments of stearine were scraped into a solution with immediate nuclear action. In such a case, the stearine furnished the film-forming material that produced the solidification of the solution. The solution was boiled with the stearine in it, and in cooling the stearine formed into solid disks without nuclear action, although the flask was frequently shaken. In this case the boiling solution had saponified or otherwise removed the film-forming matter, or, in other words, had made the stearine chemically clean.

There is also a difficulty in the case of oil of turpentine, as in the following experiment:—

Expt. 9.—A drop of an old but clear and bright oil of turpentine was deposited on the surface of a solution containing 2 parts of salt to 1 of water. The drop flashed out into a film, and the solution immediately became solid. The turpentine was now distilled, and a drop of the distillate was deposited on a similar solution, when it formed a well-shaped lens with no nuclear action, although the flasks were left out during several days.

Now the tension of the old oil first used is = 2·2, and had the effect of distillation been greatly to exalt the tension, the experiment would have been intelligible according to the theory; but on measuring it the tension was found to be only 2·4.

A somewhat similar case is given in Part II., in which an old oil of bitter almonds was strongly nuclear, while the same oil freshly distilled had no such action, but became converted into benzoic acid, still without any separation of salt. After some days, to prove that the solution was still supersaturated, it was touched with an unclean wire and it immediately became solid.

Still, however, there are such a large number of cases in which oils and other liquids spread upon the surface of the solutions with nuclear action as to justify the labour bestowed upon the theory by one of us during the last six months. Many of these cases are stated in Part II., but a few of them may be repeated here for the sake of comparing the action of such liquids upon solutions of different strengths which was not done before.

If we take a number of oils, the tension of which varies from about 2·5 to 3·5, a drop of any one of them, according to the theory, ought to spread on the surface of a solution where $t = 5·2$, and not in all cases spread on the solution of which $t = 4$.

Expt. 10.—Twelve flasks, containing a solution of

* A paper read before the Royal Society.

† *Pogg. Ann.*, cxxxix. See also *Phil. Mag.* for April, 1871.

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1 part salt to 1 of water were prepared, and a drop of each of the following oils formed films with immediate crystallisation of the solutions, viz. pale seal-oil, sperm-oil, cotton-seed oil, and niger-oil. A drop of linseed-oil formed a lens, but this soon becoming ragged, crystals diverged from it. A drop of castor-oil formed a lens with no nuclear action.

Expt. 11.—Three of the above solidified solutions were heated over a lamp, boiled, and covered over. The oil collected on the surface in innumerable small disks. Next morning one of the solutions was found crystallised, and the other two became solid on gently agitating the flasks.

In this case as the solutions cooled down or were gently agitated the disks spread out into films with nuclear action.

Expt. 12.—A solution of 3 parts salt to 1 of water was filtered into twelve flasks, when a drop of each of the following oils deposited on the surfaces of the solutions, became lenticular without any separation of salt, viz. pale seal-oil, olive-oil, rape, castor-oil, croton-oil, niger, sperm, and cotton-seed oil.

So far this result is in accordance with the theory.

Expt. 13.—A solution of the same strength as in the last experiment was employed, when a drop of seal-oil, sperm, cotton-seed, and niger spread out into films with powerful nuclear action. Linseed- and castor-oil formed lenses with no such action.

Now it must be remarked that on the day when Expt. 12 was made the weather was dull, damp, and cloudy, and during the time of Expt. 13 the weather was bright and clear. Some years ago it was a matter of frequent observation to one of us, that the formation of cohesion-figures on the surface of water was much more rapid and decisive, with altogether finer and sharper results, in bright weather as compared with dull, damp, wet, or foggy weather. The same remark applies to the motions of camphor on water, and to those curious phenomena known as "camphor currents" and "camphor pulsations."* Now in the production of all these phenomena, as has been shown by one of us,† surface-tension plays a most important part, and such tension is lowered in dull foggy weather probably by the condensation of the vapour of volatile matters contained in the atmosphere. A drop of a liquid under such conditions may not spread on the surface of water or of mercury, the latter being especially liable to such influences; whereas on a bright day such surfaces are particularly active, and experiments succeed which some hours or days before failed to produce the results expected.

Then, again, as pointed out by one of us in Part II., the viscosity of the surface, or of the drop of liquid placed upon it, may greatly interfere with the operation of the law by which a liquid B spreads upon the surface A. A supersaturated saline solution has a considerable viscosity of surface, which it retains for many hours after it has cooled down. In the course of about twenty-four hours the more watery particles come up to the surface and the tension improves, so that the same surface which may have sufficient tensile force to cause a drop of oil to spread upon it, might some hours earlier have retained it in the lenticular form.‡

There are also certain modifications to which oils, &c., are subject in consequence of the presence of ozone and other matters in the air, which may somewhat disturb the results expected to be obtained from the action of surface-tension.

It was stated in Part II. that when an oil, &c., assumes the lenticular form, the solution may be agitated so as to break up the lens into a multitude of globules, and give the solution the appearance of an emulsion. In such a case the tensions of the two liquids are of nearly the same value; if not the agitation often produces crystallisation; but even in the former case it was stated that a sudden jerk will sometimes produce immediate solidification of the solution. Now taking the tension of the solution at 5·2, and that of oil of olives at 3·7, and the tension at the surface of separation of the solution and the oil-lens at about 2, then the sum 3·7+2 is equal to the tension of the solution, and the spreading on the surface ought to be impossible, unless fine clear weather, absolutely clean vessels and solutions, and the absence of surface-viscosity, concur to increase the surface-tension of the solution. At the surface of separation of the solution and of the glass, spreading may be possible in the case of certain oils without these concurring circumstances. Suppose a drop or a minute globule of oil to be brought into direct contact with the wet solid side of the solution, as by the jerk above referred to, the film of solution is displaced and the oil can wet the solid side. It may happen that the tension t of the solution at the wall of the flask is greater than the sum of the tension t of the surface of separation of the solution and of the oil, plus the tension of the oil in contact with the solid side; that being the case, the instant solidification consequent on the jerk is accounted for.

It will be seen then that when the drop of oil, &c., remains as a lens on the surface, there is a diminution of tension at the surface of the solution in contact with the oil; but in such a case the tension is not sufficiently lowered at one point as to render molecular equilibrium impossible at this point, and so break up the whole system of supersaturation. But if the solution be agitated, so as to bring into contact with the surface of the glass a portion of the drop, there will still be diminution of tension at the surface of the solution in contact with the solid, and now the diminution is sufficient to produce crystallisation. Thus it appears that oils may act differently according as they alter the tension of the liquid freely exposed to the air, or the tension of the liquid in contact with the glass, which is not of the same value.

With respect to Proposition III. there is no difficulty. A liquid of considerable contractile force, such as pure water, produces no separation of salt in a solution of less contractile force. This explains a number of cases described in a note by one of us submitted to the Society in July last,* in which solutions exposed for hours together to heavy rain did not crystallise, unless the rain brought down a speck of soot or some unclean body that lowered the surface-tension of the solution. Indeed we know of no liquid of superior tensile force to that of the solution, and not acting chemically upon it, that has any influence in producing crystallisation.

Proposition IV. also agrees with the phenomena. A glass rod or other solid, more or less smeared with a film of a liquid of low tension, when brought into contact with the solution determines crystallisation by lowering the surface-tension. Such, then, is the function of a nucleus with respect to supersaturated saline solutions. If the solid be made chemically clean, it may be plunged into the solution without altering its tension, and hence there is no separation of salt. And here it may be remarked that such a case is possible that a crystal of the salt itself may be brought into contact with the solution without disturbing its tension, and hence be inactive. It has never been pretended that a crystal of the salt is not a good nucleus for a supersaturated solution of its own kind. All that has been stated by one of us is that, under special conditions, such a crystal may be lowered into the solution without acting as a nucleus.

* *Phil. Mag.* for December, 1869.

† "Sur la Tension superficielle des Liquides," par G. Van der Mensbrugghe.

‡ Some of the distinguished physicists who are now engaged in studying the phenomena of surface-tension refer to the embarrassing effects of surface-viscosity. Thus Herr Lüdtge remarks that a solution of soap (t=2·8 to 3) does not spread upon a solution of Panama-wood (t=5·7); and it has been shown by one of us that the viscosity of the surface explains why a solution of soap does not spread on a solution of saponine or of albumen; and, on the other hand, the liquid drop being viscous, there is no extension, or only a feeble one, since the slight difference in tension is equilibrated by the resistance of the viscous liquid.

* *Proc. Roy. Soc.*, vol. xx., p. 41.

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CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, May 27, 1872.

This number contains the following original papers and memoirs relating to chemistry:—

Iron Contained in the Blood and in Food.—Dr. Boussingault.—This exhaustive physiologico-chemical memoir treats on the part which iron plays in the animal as well as vegetable kingdom, and on the quantity of that metal present in the human body; in animals; in various vegetable substances; in water, wine, beer, and sea-water. This paper is elucidated by a series of tabulated forms, containing the results of experiments. It appears that the mollusks and other invertebrate animals contain almost as much iron in their blood as the vertebrate animals, while cryptogamic plants also contain a large proportion of the metal.

On an Aldehyde-Alcohol.—A. Wurtz.—This essay contains a detailed account of the mode of formation, combinations, and products of decomposition, of a body derived from aldehyde, and which, at the same time, plays the part of an ordinary alcohol and of an aldehyde. The formula of this new compound—which is formed when a mixture of 1 part of aldehyde, 1 part of water, and 2 parts of hydrochloric acid, is left standing for some days—is $C_4H_8O_2$, and termed aldol by the author. At 0° this substance is a very viscous fluid, having a sp. gr. = 1·1208; at a higher temperature it is as fluid as water: at above 100° it becomes decomposed, yielding water and crotonic aldehyde, C_4H_6O. Aldol reduces ammoniacal nitrate of silver and the cupro-potassic liquor; heated with anhydrous (glacial) acetic acid it is decomposed, yielding again water and crotonic aldehyde; it combines, however, with glacial acetic acid, when they are heated together on a water-bath for some days.

On a New Organic Base Derived from Sugar.—G. Bouchardat.—By treating the bromhydric and chlorhydric ethers of dulcite [$C_{12}H_{14}O_{12}$] with strong ammonia, the author has obtained a new organic base, which he terms dulcitamine, $C_{12}H_{15}NO_{10}$. The chlorhydrate of this base is prepared by heating to 100°, for a period of 6 hours, 1 part of monochlorhydric dulcitan, $C_{12}H_{11}ClO_9$, with 10 parts of a saturated alcoholic ammonia. When this compound, the chlorhydrate of dulcitamine, is treated with water and oxide of silver, dulcitamine is set free. This base is a powerful alkali, which even displaces ammonia from its combinations, and forms with acids neutral salts; the chlorhydrate of dulcitamine forms with chloride of platinum a crystalline compound, $C_{12}H_{18}NO_{10}HClPtCl_2$, insoluble in water and absolute alcohol, but readily soluble in ether.

On Bleaching-Powder.—F. Crace-Calvert.—After first referring to Dr. Balard's researches on this subject (*Annales de Chimie et de Physique*, second series, vol. lvii., 1834), the author gives an account of his method of analysing bleaching-powder, and states that this material contains, on an average, 1 part of hypochlorite of lime to 2 parts of chloride of calcium. The author experimented with samples obtained from various chemical works.

Production of a Crystallised Phosphuret of Iron.—M. Sidot.—By passing the vapours of phosphorus over incandescent piano-wire (iron), the author obtains, after re-melting the first product, a highly magnetic crystalline phosphuret of iron, containing in 100 parts—Iron, 87·9; phosphorus, 12·1; formula, Fe_8Ph.

La Revue Scientifique de la France et de l'Etranger, June 1, 1872.

This number does not contain any original chemical papers, but we call attention to the following interesting memoir:—

History of the Observatory at Paris.—E. Yung.—This paper is divided into the following sections:—Origin; period of the Cassinis (1671—1793); period of the Convention (1793—1795): period of the Bureau des Longitudes (1795—1854); period of independent directors (1854—1872). In a sense this paper proves "que la France intelligente, éclairée et libérale ne périt pas," although the motto of the Parisian coat of arms, "Fluctuat nec Mergitur," applies to "la belle France" in many respects.

Continuation of the Lectures on Animal Heat.—Dr. C. Bernard.

June 8, 1872.

This number contains no original papers relating to chemistry, but we call attention to the continuation of the excellent lectures—

On Animal Heat.—Dr. C. Bernard.

American Journal of Pharmacy, June, 1872.

In addition to several important papers more particularly relating to pharmacy and pharmacognosy, this number contains the following original papers bearing upon chemistry:—

Citrate of Iron and Bismuth.—C. Rice.—The author describes the preparation of a liquid which contains citrate of bismuth and citrate of iron together in solution, the first-named salt being dissolved in dilute ammonia; ammonio-citrate of iron is added, and then—in order to make the solution keep—either glycerine or, better still, good sherry wine is added. This preparation is largely used in the United States in dyspepsia.

New Process for Detecting Bromide in Iodide of Potassium.—Dr. E. van Melckebeke.—If to a saturated solution of bromide of potassium a small quantity of pure iodide is added, it will completely dissolve, but if the iodide is contaminated with bromide of potassium this impurity will remain undissolved; 100 parts of water (distilled), at 16°, dissolves 140·10 parts of iodide of potassium, and the same quantity of water, at the same temperature, dissolves 63·39 of bromide of potassium; 100 parts of water saturated with bromide dissolve only 13·15 parts of iodide of potassium, and if more of that salt is added bromide is precipitated. As the solution of the salts in water causes a very sensible lowering of temperature, for testing the author recommends to dissolve pure bromide of potassium in warm water, to let this solution cool, and decant from the crystalline deposit. To 10 c.c. of this solution, 10 drops of water are added in a test-tube, and afterwards in small quantities, and, constantly shaking 1 grm. of the suspected iodide in coarse powder, if free from bromide it will dissolve almost instantly, while if bromide is present it will remain undissolved.

Annalen der Chemie und Pharmacie, No. 7, 1872.

This number contains the following original memoirs and papers:—

On Chrysanissic Acid.—Dr. H. Salkowski.—Too extensive for useful abstraction. It is divided into the following sections:—Introduction, containing a review of the labours and researches of others on this subject; preparation of chrysanissic acid; properties and combinations of this acid; products of decomposition of this acid; re-formation (*Rückbildung*) of chrysanissic acid; its formation during its preparation; dinitro-anisic acid; constitution of chryso-anisic acid and substances isomeric with it.

Influence of the Potassa and Soda Salts upon Alcoholic Fermentation.—C. Knapp.—After first referring, at some length, to the researches of physiologists on the action of the potassa salts upon the animal organism, the author details at length a series of experiments made with the view to ascertain the difference of action—if any—upon the process of fermentation of sugar solutions to which yeast is added. While it is evident, from these researches, that potassa salts accelerate the fermentation, while soda salts are inactive, the mode of action of the first-named salts is not precisely clear.

Researches on the Pigments Present in Bile.—R. Maly.—The third and concluding portion of this monograph treats of the conversion of bilirubin into urine-pigment.

Preliminary Communication.—E. Linnemann.—The main gist of this brief paper is, that the combination of acrylic acid with hydriodic acid is identical with the glycerin-iodpropionic acid.

Contribution to our Knowledge of the Cochineal Pigment.—C. Liebermann and W. A. van Dorp.—This exhaustive monograph is divided into the following sections:—Introduction, containing an excellent review of the labours of others on this subject; nitrococcic acid; trinitro-cresol; binitro-amido-cresol; ruficoccin; by-products of the preparation of ruficoccin.

Researches on Isomerism of the Benzol Series.—F. Beilstein and A. Kuhlberg.—The fourteenth instalment of this monograph. This part treats on cinnamic and benzoic acids; preparation of cinnamic acid; nitro-cinnamic acid; nitro-hydro-cinnamic acids; meta-nitro-benzoic acids; anthranilic and salicylic acids from metanitro-benzoic acids; nitro-α-toluyl acids; indol; nitrophenyl-chlorolactic acid; tyrosin.

Action of Active Oxygen upon Pyrogallic Acid.—H. Struve.—This essay contains the detailed account of a series of experiments made with the view of ascertaining the action of oxygen (superoxides) and ozonised oil of turpentine on pyrogallic acid. It appears that the last-named substance is completely converted into purpurogallin—a body described by Aimé Girard (*Zeitschrift für Chemie*, 1870, p. 86).

On Water-Baths with Constant Level.—J. L. Smith.—The detailed description of a contrivance for keeping water-baths—while in use in chemical laboratories—filled with a sufficient quantity of water.

Le Moniteur Scientifique Quesneville, May 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Essay on the Docimastic Extraction of the Bismuth Ores, and the Docimastic Method of Separating this Metal from Copper, Arsenic, Antimony, and Lead.—H. Tamm.—This exhaustive memoir is divided into the following sections:—Assay of bismuth ore; assay of bismuth ores containing much copper, and extraction of the metal from such ore; method of separating, on the large scale, arsenic from bismuth; method of separating bismuth from antimony; method of separating copper, sulphur, and lead, from bismuth,—all on the large metallurgical scale.

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The Phosphates of Lime of Russia.—A. Yermaloff.—This paper, illustrated by a map exhibiting a portion of the Russian Empire, contains an account of the situation and extent of phosphate of lime deposits in that country. It appears that there are several very extensive deposits of native phosphate of lime, one of which occupies a surface of no less than 20,000,000 of hectares, each of which (=2·471 acres) will yield some 14,000 tons of this mineral, which on an average has been found to contain, by analysis, about 20 per cent of phosphoric acid.

Best Methods of Analysis of Artificial Manures.—L. Fresenius, C. Neubauer, and F. Luck.—This monograph is divided into the following chapters:—Methods of estimating phosphoric acid in general; special methods of estimating phosphoric acid; estimation of precipitated phosphates in superphosphate of lime.

Bibliography.—Under this heading we quote the title of the following work, which is very highly spoken of in the periodical above-named:—"Chimie Organique Elémentaire," par Edouard Grimaux: Paris, Germer-Baillière, 1872.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, April 11, 1872.

Physical and Chemical Properties of Various Kinds of Brass.—C. Mène.—A tabulated form, exhibiting the chemical formulæ, composition in 100 parts, sp. gr., atomic weight, colour of the fracture, breaking-strain in pounds, degree of ductility, degree of hardness, and degree of fusibility, of a number of alloys of copper and zinc.

Rapid Dryer (Siccatif) for Oil-Paints and Varnishes.—C. Mène.—In 100 parts of water are dissolved, by the aid of heat, 12 parts of best shellac and 4 parts of borax; this solution, after cooling, is poured into bottles, which should be well corked. According to the author, this solution may be mixed with some oil of turpentine, with oil-paints, to render them rapidly drying, while the liquid may also be employed as a varnish.

Glycerine as a Tanning Material.—C. Mène.—After first observing that glycerine is a substance which has been found by experience to be useful as a means of increasing the elasticity and strength of leather, the author states that leather (hides rather), first partly tanned by the usual process, may be greatly improved—especially if required for machine-belts—by being soaked for some time in glycerine.

Studies on Dynamometers.—C. Mène.—The continuation of an essay on this subject, copiously illustrated with woodcuts.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 233, May, 1872.

The only original paper relating to chemistry met with in this number is—

Report on an Ink which does not Corrode Steel Pens.—Dr. Balard.—This exhaustive memoir contains much valuable information on inks in general. The use of inks of a similar composition to that now generally employed appears to be of more ancient date than is generally supposed, because the author mentions, in the historical introduction to his report, that on examining a manuscript of the year 910, and belonging to the papers of the Cluny Abbey (Paris), it was evident that the ink it was written with was similar in composition to that now in use: it further appears that MM. Coupier and Collin have succeeded in preparing an ink which very nearly answers to the conditions required by the Society for its prize medal, which, however, has not yet been granted to MM. Coupier and Collin, though in order to encourage their labours a sum of £20 has been awarded them. This ink is well worthy of general notice, as it is not acted upon by nitric and hydrochloric acids, chlorine, or bromine; it is, however, not quite proof against alkalies.

Gazzetta Chimica Italiana, Nos. 2 and 3 (double number), 1872.

This number contains the following original papers and memoirs:—

On Anisic and Methylsalysilic Alcohols.—S. Cannizzaro and W. Koerner.—The authors give an account of their researches on the anisic-alcohol as compared with the therewith isomeric methylsalysilic alcohol (methylsaligenin). The first-named product has been prepared by the action of alcoholic potassa upon anisaldehyde, while the methylsaligenin is prepared by adding to a solution of saligenin in wood-naphtha the requisite quantity of potassa to form first—

$$C_6H_4\begin{cases}OK\\CH_2OH.\end{cases}$$

which is next boiled with iodide of methyl. Methylsaligenin is at the ordinary temperature an oily fluid which is difficultly solidified when exposed to the action of a mixture of solid carbonic acid and ether; anisic alcohol is crystalline, and fuses at 25°.

Anisic-alcohol.	Methylsaligenin.
Boiling-point 258·8° at 760 m.m.	Boiling-point 247·5° at 765 m.m.
Sp. gr. at 26°=1·1093	Sp. gr. at 23°=1·1200
,, ,, at 100°=1·0507	,, ,, at 100°=1·0532.

Measurement of the Index of Refraction of Anisic and of Methylsalysilic Alcohols.—P. Blaserna.—An algebraico-optical essay.

Detection of Iodine when Present in Urine in the State of an Iodide.—Dr. P. Pelloggio.—The main gist of this essay is that, according to the author's researches, electrolysis of iodine containing fluids, previously mixed with hydrochloric acid and starch-water, is the most sensitive method for detecting very small quantities of iodine.

Nature of the Colouring Matter met with on the Urn of St. Ambrosius, at Milan.—R. Frapolli, R. Lepetit, and P. Padulli.—On the urn of St. Ambrosius,—dating from the ninth century,—being recently opened at Milan, it was found to contain along with earthy matter some colouring substance, which, on being tested by the authors, was found to consist of indigo and shellac.

New Method for Detecting Fuchsin.—G. Romei.—The author refers at considerable length to the researches of various authors who have devised methods for detecting fuchsin in syrups, sweets, &c. It appears that wines are also sometimes artificially coloured with fuchsin; and the author proposes to treat the wines with amylic alcohol after previous treatment with acetate of lead for precipitating the peculiar wine-colouring pigment.

Chemico-Microscopic Research of a Peculiar Substance which Accompanied the Meteoric Dust which Fell in Sicily on 9th, 10th, and 11th March Last.—O. Silvestri.—The peculiar substance, designated popularly as blood-rain, was found to consist in 100 parts of red iron ochre, 75·1; carbonate of lime, 11·7; organic matter, 13·2.

Programme de la Société Hollandaise des Sciences de Haarlem, 1872.

From this paper we learn with pleasure that an Englishman has had awarded to him the first "Boerhaave" medal—the gentleman being Mr. H. Clifton Sorby, F.R.S., of Sheffield, who has obtained this distinction for his excellent microscopical researches in reference to mineralogy and geology. Mr. Sorby has been elected one of the foreign members of this ancient scientific institution, an honour likewise conferred upon Dr. C. A. Würtz of Paris, and the Right Hon. Lothrop Motley, temporarily residing at the Hague. We quote from this programme the following prize-questions relating to chemistry:—To be answered on or before 1st January, 1874: To study in detail the influence which physical and chemical modifications of the dissolving agent exert upon the form of carbonate of lime when it is deposited from aqueous solutions; what are the chemical changes which stone-bearing fruits undergo during their development? to be elucidated by original chemical researches and analysis; to find satisfactory means for determining the temperature, degree of hygroscopicity, and the density of the atmospheric air at a considerable distance above the earth's surface; these means ought to be either such that automatic registration is possible, or so contrived that the observations can be frequently repeated. In addition to the gold medal (the ordinary prize) a sum of £25 will be awarded for satisfactory answers to this question.—To be answered on or before 1st January, 1873: Exactly-made determinations of the density (sp. gr.) of pure water *free from air* at different temperatures expressed in degrees of the air thermometer; quantitative chemical analysis to be made of different kinds of glass of which the co-efficient of refraction is known; new researches to be made on the liquids and gases occluded in small cavities of native crystals. The memoirs to be written (not, however, in the handwriting of the authors) in Dutch, Latin, English, French, Italian, or German languages (not with German characters), and to be accompanied by a sealed note, bearing inside the author's name, and outside a motto, also to be written on the fly-leaf of the memoir, to be sent, carriage or postage paid, to Dr. E. H. von Baumhauer, secretary of the Society at Haarlem, Holland. The sealed notes of the memoirs to which no prize is awarded are destroyed unopened unless the memoir is found to be a copy or abstracts from printed works. The ordinary gold medal of the Society, the prize awarded, has an intrinsic value of £12 10s., while in some cases that sum is added to the medal.

Les Mondes, June 6, 1872.

This number contains no original papers relating to chemistry or collateral matters.

NOTES AND QUERIES.

Iodine.—I wish to estimate the percentage of iodine in such products as kelp. Can any reader kindly recommend a method combining quickness and accuracy?—J. S.

Salts of Chromium.—I am anxious to learn whether it is possible to make salts of chromium perfectly free from iron either commercially or as laboratory specimens?—CHROMIUM.

MEETINGS FOR THE WEEK.

MONDAY, June 24th.—Royal Geographical, 8½.
WEDNESDAY, 26th.—Society of Arts, 4.
THURSDAY, 27th.—Royal Society Club, 6½ (Anniversary).
—— Philosophical Club, 6.
FRIDAY, 28th.—Quekett Club, 8.

TO CORRESPONDENTS.

T. R. Y.—Cooley's "Cyclopædia of Practical Receipts" is published by Messrs. J. and A. Churchill, price 28s.

J. Parry, W. Thorp, jun., S. E. Phillips.—These correspondents are thanked for their communications, which shall receive attention.

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THE CHEMICAL NEWS.

Vol. XXV. No. 657.

ON THE OXIDATION BLUE OF BOLETUS CYANESCENS, B. LURIDUS, &c., AND ON A SIMILAR PRODUCT DERIVED FROM PHENOL.

By T. L. PHIPSON, Ph.D, F.C.S., &c.

In a former paper* I attributed the intense blue colour produced by hypochlorite of lime in the alcoholic solution of the yellowish colouring matter of *Boletus luridus*, &c., to the presence of phenylamine (aniline) in the tissue of these fungi; though, in the absence of sufficient data relative to the composition of the colouring matter, this opinion was put forth as little better than a conjecture.

Recently a paper on the same subject has been published by Mr. H. Ludwig,† whose method of experimenting has not enabled him to detect aniline, though he has convinced himself of the presence of nitrogen in the colouring matter; and had he pushed his investigation a little further, I am convinced he would have obtained some phenyl derivative also.

I have more recently obtained, artificially, a blue colour exceedingly like that yielded by oxidation of the freshly-cut surface of these *Boleti*. A small quantity of ordinary phenol is dissolved in methylic alcohol saturated with ammonia. To this, hypochlorite of lime is added cautiously, in small quantities, until an intense blue colour is produced. This is soluble in water. The aqueous solution, considerably diluted and acidified by hydrochloric acid, is reddish or pinkish, but after a while deposits a small quantity of a dark resinous substance, and then it is a clear yellow solution, which in presence of ammonia takes a blue colour, in a very few minutes, *by contact with the air*.

This yellow solution, to which a few drops of ammonia have been added, behaves exactly like the freshly-cut surface of *B. luridus*, and the ephemeral blue colour produced is very similar to that of the fungus, though they may not be absolutely identical in composition. Nevertheless, this experiment induces me still to believe that the blue colour derived from *Boleti* belongs to the phenyl group.

ESTIMATION OF CARBON IN PIG-IRON, WROUGHT-IRON, AND STEEL, BY COMBUSTION WITH OXIDE OF COPPER IN VACUO UNDER SPRENGEL PUMP.

By JOHN PARRY, F.C.S.

In the course of experiments now in hand, with the view of estimating the amount and kind of gas occluded in pig-iron, &c., it was thought necessary to heat the iron with oxide of copper *in vacuo*, and it was found that accurate carbon determinations could be made as follows:—

(1). Digesting the metal in solution of $CuSO_4$, filtering and washing residue of precipitated copper mixed with the carbon through asbestos.

(2). The dried residue mixed with about 50 grms. pure oxide of copper, and placed in a combustion-tube sealed at one end and drawn out at the other, the drawn-out end being fitted into a water-joint connected with the pump, as shown in Frankland and Armstrong's Memoir (*Chemical Journal*, vol. vi., p. 90). A vacuum being first formed, the tube was heated to a red-heat until gas ceased to be evolved. The gas was collected in a carefully-calibrated gas-tube, and measured with the usual corrections for temperature, pressure, and moisture, the amount of carbon being calculated from the number of c.c., measured according to Bunsen. Several trials were made with iron direct mixed with CuO, but all failed to give the full amount of carbon.

A sample, ascertained to contain 3·2 per cent carbon, kept heated under pump for more than 12 hours, gave only 2·97 carbon, with CO_2 gas still being evolved. Other trials—heat kept on from 2 to 4 hours—gave 2 to 2½ per cent carbon.

It was found, in all cases, that the gas given off *in vacuo* consisted entirely of pure CO_2, but that care was necessary to insure the perfect purity of the CuO used and freedom from dust.

Expt. 1.—*A* grey pig-iron. 1 grm., heated 1 hour under pump, gave 59·8 c.c. CO_2 = carbon 3·206 per cent; ditto, by ordinary combustion with CuO in current of O, carbon (1) 3·280, (2) 3·264. To experimentally test the calibration of the gas-tube a light glass flask, about 100 c.c. capacity, was fitted with a capillary tube and glass stopcock. This was connected with the pump, and, the air having been exhausted the stopcock was closed, the apparatus detached from the pump, and weighed. By passing the capillary tube up the tube containing the gas, and opening the stopcock, the CO_2 gas was drawn into the flask.

First weight exhausted flask	..	23·2⅞ grms.
Second weight with CO_2 drawn in		23·333 ,,
		CO_2 0·059

Carbon 3·206 per cent.

Expt. 2.—Another sample grey pig-iron. (1). Ordinary combustion, carbon 3·600 per cent. (2). Under pump, gas pumped direct into weighed KO bulbs, carbon 3·654 per cent.

Expt. 3.—It being thought probable that by ordinary combustion CO_2 might be retained in the oxide of copper, 1 grm. of *A* grey pig-iron was treated with solution of $CuSO_4$, washed, &c., mixed with CuO, and placed in a combustion tube, drawn out so as to admit of detaching the O-generating apparatus, and, readily sealing the end in the blowpipe flame, gave carbon 3·228 per cent. The O apparatus was detached, the tube sealed up and allowed to cool; when cold the tube was attached to the pump, exhausted, and again heated. A considerable quantity of gas was given off, which was found to be pure O, without the slightest traces of CO_2 and CO.

Expt. 4.—Puddle bar, described as being thoroughly puddled iron. Ordinary combustion, carbon (1) 0·143 per cent, (2) 0·131 per cent. Combustion *in vacuo*, carbon 0·1465 per cent.

Expt. 5.—Wrought-iron armour-plate. Combustion *in vacuo*, carbon 0·1426 per cent.

Expt. 6.—Steel. Combustion *in vacuo*, carbon 0·2972 per cent. Eggertz's colour test, carbon 0·2800 per cent.

It appears, therefore, that the ordinary combustion method with CuO in O gas gives fairly accurate results. The author is, however, of opinion that more *sure* results may be obtained by the use of the Sprengel pump; and although the method appears more tedious, and requires some manipulative skill, yet, if the pump be properly fitted up and the gas-tubes carefully calibrated, combustions may be made with great facility.

Ordinary combustions require the undivided attention of the operator, and, from the number of parts, considerable care in guarding against leakage; moreover, the KO bulbs present a considerable surface for the deposit of dust and moisture,

* "Sur les Bolets Bleuissants, &c.," Bruxelles, *Journ. de Med.* 1860 (and, same year, *Comptes Rendus*, Paris, "De la Présence de l'Aniline dans certains Champignons.")

† *Journ. of the Chem. Soc. Lond.*, May, 1872, p. 424.

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With the pump, the vacuum once being secured and preserved to the end of the combustion, there is no fear of error from leakage, and the operator—having the CO_2 gas in the tube—can leisurely verify his measurements, &c., and also test the gas for CO_2 by passing up a potash ball, and, provided pure CuO is used and the combustion-tubes are clean, can absolutely depend upon first results. As far as the author's experience goes, such is not the case by the ordinary method.

When a careful determination of carbon in steel or wrought-iron is required, two trials must always be made; the writer, as a rule, makes three determinations by the old method.

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ON CERTAIN NEW PHENOMENA IN CHEMISTRY.*

By VERPLANCK COLVIN.

The subject of this paper is so broad and varied, the phenomena so interwoven and connected with different branches of material science, that the title is but a slight index to its character, and the paper itself can be only a brief statement of facts, with such deductions as may seem to follow. It might have been entitled "An Account of Mercury and its Amalgams." As that, however, is not exactly the scope of the paper, nor the final object of it, but only the means or vehicle of communicating some ideas—which I hope will prove to be new—it may be allowed to stand here as a suggestion as to the character of the matter which is to follow.

With the discovery, by Sir Humphry Davy, of the metals of the alkalies and earths, a new era opened in chemistry. The sombre clouds which non-experimenting theorists had cast around the science were suddenly and violently dissipated in the blaze of simple truth, and one of those epochs occurred which must from time to time recur, as man acquires mastery over matter. As the theories of Stahl and his *phlogiston* had been pressed down and swept away by the discoveries of the previous century, so the accumulated errors of the intervening age were overthrown by Davy's investigations, and the new metals were evolved by electrolysis in the form of amalgams or compounds with mercury. A few of the metals of the earths, however, could not be thus procured, and their existence was only rendered probable by the analogous action of their salts or oxides when under similar treatment. These discoveries not only gave to chemistry a list of new metals, but with every one actually evolved a new amalgam. Thus, to the list of amalgams known to the ancients, were added numerous new compounds, while the general character of the elements so associated was of the most dissimilar kind. One property only seems peculiar to the majority of them, softness or malleability, and ductility. To this class of easily amalgamated elements belong such old metals as gold, silver, copper, tin, and lead; and such new metals as potassium, sodium, and calcium.

The other class of metals is peculiar in combining but slightly or not at all with *pure* mercury; and these metals, like those in the preceding class, seem to have but one general characteristic, the reverse of that of the first class, hardness, and at times even brittleness.

Iron, probably, alone of all the metals known to the ancients, belongs to this second class; while of the new metals which seem to belong to it, chromium, columbium, titanium, manganese, zirconium, and perhaps rhodium, are examples. Singularly enough platinum and aluminium, malleable and ductile metals, appear to be attached to this class by reason of the difficulty experienced in directly combining them with pure mercury. It is therefore plain that the proper classification of metals as regards their affinity for mercury is their separation into these two divisions; the *first* consisting of metals that readily combine with pure mercury; the *second* consisting of metals which refuse to combine with pure mercury, at a moderate temperature.

One of the consequences of the discoveries of Sir Humphry Davy, was the application of the amalgams of potassium and sodium to purposes of exploration in chemistry. Berzelius and Pontin obtained their ammonium amalgam by the direct electrolysis of aqua-ammonia in contact with mercury. But afterwards it was observed that this amalgam could be made by the action of potassium or sodium amalgam upon chloride of ammonium. It has been stated that the amalgams thus procured are not exactly similar, the amalgam prepared by the method of Berzelius having a composition according to H. Davy of one part of ammonium to 753 of mercury, and crystallising in cubes when cooled to zero centigrade; while that prepared with the aid of potassium and sodium amalgam contains according to Gay-Lussac and Thénard, one part of ammonium to 1800 parts of mercury.

The discovery by Graham of the metallic nature of hydrogen gas, as evinced by its occlusion in, or alloys with, palladium and platinum, enables us to avoid the difficulty of believing in the existence of a metal or "element compounded of gases"—which is an hibernicism—by supposing ammonia to be an alkaline nitrogen salt of the metal hydrogenium. Then, allowing that the light cellular or frothy state of the so-called ammonium amalgam is owing to the existence throughout the mass of molecules of released nitrogen, clinging to, and re-combining with, the rapidly re-oxidising hydrogenium, we account for the ammoniacal gas afterwards given off. We might then suppose that hydrogenium is the metal of the volatile alkali, ammonia, having little resemblance to magnesium, which Graham believed to most resemble it. This, however, is only an hypothesis, and is indeed a digression.

The potassium and sodium amalgams enable us to form, besides this hypothetical amalgam, compounds of mercury with those metals which I have arranged in a second class, as refusing to combine with pure mercury at a moderate or low temperature. The process is simply placing potassium amalgam, or its substitute, excited with some corrosive gas, solution of a salt, aqua-ammonia, water or acid (as the case may require) in contact with the metals to be amalgamated. A triple amalgam of mercury, potassium or sodium and "ammonium" (hydrogenium?) is sometimes useful; and I have found zinc amalgam, excited with chlorhydric acid, a powerful agent in producing these results.

And now, before proceeding to describe those phenomena of the discovery of which I can find no record, it is advisable to examine into the nature of mercury and its amalgams, and the present state of our knowledge of its compounds.

Remembering that the fluid mercury with which we are familiar is but the molten substance of a solid ductile and malleable metal, we arrive at the conclusion that amalgams are simply the *alloys* of mercury, as metals dissolved in melted lead would be alloys of lead. Now the alloys of mercury are peculiarly easy to examine; for even when in the fluid state they do not burn one's fingers, and by analysing amalgams we are able to discover the condition of the metals contained in them. Having prepared an amalgam of gold and dissolved it in an excess of mercury, I treated the fluid amalgam with nitric acid. When the quicksilver had entirely dissolved, there remained a small spheroid of gold, dark upon the surface, and when broken apart under the hammer, exhibiting a radiating crystallisation like that of globular iron pyrites. This, and other experiments (which I have not time to describe), appear to prove that a metal when amalgamated is really dissolved; and it is possible that if the reduction of the amalgam had been less rapid, a well-formed crystal of gold might have been obtained. The metals of the second class seem also to be actually dissolved in the mercury.

* A Paper read before the Albany Institute.

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Our knowledge of the compounds of mercury, as derived from the latest standard works on chemistry, is singularly imperfect. Ste.-Claire Deville, the famed chemist of the late French empire, the discoverer of the economic process of aluminum manufacture, asserts that metallic aluminum is not susceptible of amalgamation. Prof. W. A. Miller, in his "Inorganic Chemistry" (third edition, p. 425) also says of aluminum:—"It does not combine with mercury." Yet in Watts's "Dictionary of Chemistry," published in London three years previous to this record in Miller, we find that, "According to Cailletet (*Comp. Rend.*, 44, p. 1250) aluminum (also iron and platinum) may be superficially amalgamated by contact with ammonium or sodium amalgam and water; also when immersed in acidulated water, in contact with metallic mercury, forming the negative pole of a voltaic battery." This, published in London, 1865, appears to ante-date the discovery of the method of amalgamating aluminum with the aid of sodium amalgam by some two years; but both discoveries are obviously genuine. Again, both Miller and Watts seem not to be aware of any method of combining mercury directly with metallic platinum, in the form of foil or wire, and describe an indirect method of obtaining it, by the electrolysis of chloride of platinum. Yet potassium or sodium amalgam will readily effect the combination. A few years since, while experimenting with the amalgams of the alkaline metals, I observed that a common iron nail which happened to fall into the amalgam, became coated with mercury. For a time I believed myself the discoverer of iron-amalgam, but on examination I have found mention of it more than thirty years upon record. Aiken (*London Phil. Mag.*, xiii., p. 416), shows that it may be accomplished with the aid of zinc amalgam and a solution of chloride of iron. Watts says (*l. c.* iii., p. 887), "Mercury and iron do not unite readily. A viscid amalgam is, however, obtained by immersing sodium amalgam, containing one per cent of sodium, in a clear saturated solution of ferrous sulphate. Joule (*Chem. Gaz.*, 1859, p. 339; *Chem. Soc. Journ.*, xvi., p. 378), has obtained amalgam of iron by electrolysis of a solution of ferrous sulphate, the negative pole being formed of mercury." None of these authors appear to be aware of any method of directly amalgamating iron, yet H. Davy distinctly states that either potassium or sodium amalgam will effect the union of mercury with iron and platinum.

Mercury has been employed from time immemorial, in separating the precious metals from their earthy associates. Originally the *pure* metal was employed, as indeed it still is to a considerable extent, held in little rifts or gutters in the trough or sluice where they washed the auriferous sands or pounded ore. This was also the method of amalgamation at the stamp-mills, and it is notorious that much gold passed over the mercury in this process, and escaped. Recently I observed in the gold mining regions of the Rocky mountains, at Central city and Nevada, Colorado, that for the rifts and gutters filled with mercury, they had substituted sheets of copper, superficially amalgamated, over which the ore reduced to a thin mud, or muddy water, was washed, its gold parting and adhering to the surface of the amalgamated copper, and doing so more readily than it would to the surface of pure mercury.

Here we have another instance of that *combination-action* which we have already noticed in the potassium and sodium amalgams, as evinced by their power to unite mercury with the metals of the second class. It appears that those metals of the first class which are softest, lightest, and most easily oxidised (as potassium, sodium, zinc, &c.), have the power to enable the harder, heavier, and least oxidisable metals of the same class (as copper, silver, and gold), to combine more readily with mercury than they would unassisted; and, further, to enable mercury to combine with the metals of the second class, which though generally harder and more brittle than any of the preceding, are often readily oxidised. This *combination-action* separates the alloys of mercury from all other alloys, so far as we now understand them; for, as I have already shown, instead of the mercury always losing power as a metal solvent in proportion as it becomes alloyed—it shows a preference,—and when combined with portions of the readily oxidisable metals, becomes more active and indeed almost ferocious in its appetite for the metals and alloys that are of a highly electro-negative character; while if alloyed with sufficient gold or silver in the first instance, it appears satisfied, phlegmatic, and indifferent to further metallic food. Experiments which I have made demonstrate that cyanide of potassium *does not* answer as well as the amalgams of the alkaline metals, in effecting the union of mercury with electro-negative metals, as some have asserted. Its solution is, indeed, not more effective than aqua-ammonia in producing such results, and what efficacy either of these solutions possess may be attributed to their cleansing the surface of the metal to be amalgamated.

It now becomes evident that the separation of metals into the two classes is incorrect, as we have here, as in every other general classification in science, no absolute division, but merely extremes and means; the true mean being difficult to determine. The reactions of these amalgams of the electro-positive metals with those metals which are relatively electro-negative, are very instructive. They tend to prove that all the amalgams subsequently formed are the results of *electrical action*, to induce which we have only to place a particle of iron in contact with potassium amalgam and with water. In an instant we have a voltaic battery in active operation; the amalgamated potassium forming the "zincode," while the iron is the electro-negative element of the battery. Of the metals present the mercury is the electro-mean, and with the oxidation of the potassium, it passes over to and effects a combination with the iron.

Thus we arrive at a more correct classification, and at a law of preference of metals and alloys for mercury:—

1st Law.—Metals that are easily alloyed with mercury give place to and assist the less amalgamatable metals in combining with mercury, when in the presence of an acid or corrosive liquid or atmosphere, which attacks the metal already amalgamated, and which does not attack, or does not so violently attack, the metal to be amalgamated.

2nd Law.—The more intense the action of the acid or corrosive liquid or gas upon the metal in the original amalgam, the more rapid the formation of the secondary amalgam.

3rd Law.—The amalgams of electro-positive metals assist those metals which are relatively electro-negative in combining with mercury.

These laws are the results of certain experiments which, as examples, I will now proceed to describe and illustrate. Placing before us mercury—1st, in the pure state; 2nd, amalgamated with copper; 3rd, zinc amalgam; 4th, aluminum amalgam; 5th, sodium amalgam; 6th, potassium amalgam; and 7th, "ammonium amalgam" (hydrogenium?)—we may suppose that we have the extremes and some of the means of mercurial power; mercury in the *pure passive* and in the compound induced *active* state. To prove that it has a passive and an active condition, it is only necessary to exhibit gold leaf before the pure mercury and each of the several compounds mentioned.

First.—It will be seen that with mercury alone it does not readily amalgamate, and there is no attraction of the gold leaf toward the metal.

Second.—Held above the amalgamated copper there is no attraction, but the moment the gold is allowed to touch the surface, it is eagerly seized and devoured.

Third.—Held above zinc amalgam excited with chlorhydric acid, the gold leaf begins to waver and tremble slightly as though influenced by the amalgam. Touched to the amalgam it is seized and vanishes instantly.

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Fourth.—Above the sodium amalgam, excited with water or aqua-ammonia, we have the same symptoms, but even more excitement and eagerness on the part of the gold leaf to pass to the amalgam as it is approached; and the gold is scarcely touched ere it is gone, licked up by the hungry amalgam.

(This action is only seen when but short distances intervene between the gold leaf and amalgam, an eighth or sixteenth of an inch. To perform the experiment successfully, the water should just cover the amalgam, and the edge of the gold leaf should be allowed to dip a little into the water.)

Fifth.—With potassium amalgam the action is greater.

Sixth.—With the hypothetical hydrogenium or ammonium amalgam, I have found *less action* than the supposedly high electro-positive character of the metal (?) would indicate. This might be accounted for by the porous condition of the amalgam, owing to the gas contained (nitrogen?) and consequently much diffused state of the "metal." I notice this last experiment and reaction merely because it may be valuable in determining whether such gaseous metals exist.

The result here seems to be that we have now for the first time a metallic compound capable of attracting the precious metal gold, when but a short distance intervenes. We can amuse ourselves with the idea that upon this principle a compass may be constructed (a tube charged with the amalgam), which will be to the prospector and gold hunter as the magnetic dip needle is to the searcher after iron ore. Still, there is something inexplicable about it, for this apparent attraction of gold can hardly be magnetic, and it seems to me we must look for explanation to cohesive molecular power.

I have shown that the combination of mercury and iron was long since effected; I have now to claim as a discovery the direct amalgamation of *steel*, even when of the toughest and hardest character. The blade of the best pen-knife is readily amalgamated, and suffers from the contact, while a plate of fine sheet steel, used in the manufacture of superior instruments, is easily coated with mercury and made to resemble a sheet of silver. By magnetising soft steel, reducing a sufficient amount of it to filings, and dissolving the filings in mercury, I have procured a magnetic amalgam, in the presence of which an astatic needle is decidedly bewildered. The horseshoe magnet which has this evening been exhibited brightly coated with and upholding an inverted arch of fluid, dripping mercury, lifts quicksilver, it is true, but quicksilver loaded with an amalgam of magnetised steel; an attraction much stronger than that evinced for iron amalgam.

A glass tube properly charged with the magnetic amalgam exhibits the polarity of the compass needle, and has its extremities attracted and repelled by the poles of the magnet in the same manner that the poles of the compass needle are attracted and repelled. This property of the magnetic amalgam is interesting, as it proves that however minutely divided, the atoms of steel still retain their magnetism, and are still influenced by the directive currents of the earth. I have not yet been able to make a very powerful needle of this kind; but, though my observations are very imperfect, I am able to say that it seems to point a little more truly to the magnetic north, and from its greater inertia to be less subject to irregular changes of variation than the ordinary compass needle. The inertia is to be attributed to the assumption by the magnetised steel of a certain portion of the weight or specific gravity of the mercury. When this amalgam is exposed to the oxidising influence of the atmosphere, it is gradually decomposed, carbon being liberated, and the permanent magnetism vanishing, while iron amalgam remains. This will also finally decompose, pure mereury and ferrous oxide resulting.

Another discovery that I may claim, is the direct amalgamation of *cast-iron*, even of the most brittle and highly *carburetted* character. This was first effected by means of a compound amalgam of potassium, sodium, and "ammonium" with water; but I have since found that a simple amalgam of potassium or sodium is generally sufficient to effect the result. The surface of cast-iron may be amalgamated by placing an electro-positive or active amalgam upon it with water or an acid; a true amalgam may be similarly formed with filings.

In the course of the experiments which led to this discovery, it was my fortune to observe phenomena of an extraordinary character. The usual brilliant surface of mercury is produced when cast-iron is treated with the electro-positive amalgam, and the iron is rapidly "cut" or dissolved. The impurities of the iron, with considerable carbon, are released and form a black mud around the button of amalgam. If at this moment, before all the positive metal has been oxidised, the amalgam be removed, washed, and allowed to stand, particles of amorphous carbon will be seen to emerge and float upon its mirror-like surface. Whence comes this carbon; why was it not given up before? Has it been amalgamated; and if so, has it not a metallic character? It has been suggested to me that particles of undissolved iron, containing carbon, have been carried bodily into the amalgam, and afterwards dissolved, releasing their carbon. However, this is but a conjecture; the reaction certainly deserves study.

The mere intimation that carbon, the great proteus thing in nature, may, after all, have a metallic origin, is very interesting. Those who believe in the ammonium of Berzelius or the hydrogenium of Graham, need not fear to examine the claims of carbon to a metallic parentage, nor does the existence of such a metal seem so improbable when we remember the electric conductibility of two of the allotropic forms of carbon, gas-coke and plumbago; the first already replacing, in the voltaic batteries of the present day, the electro-negative elements, platinum, copper, &c., while the latter replaces similar electro-negative elements when brushed, in the form of plumbago powder, upon the surface of the mould or plaster-cast which the electroplater desires to coat with copper or other metal.

If metallic carbonium exists, it may be assumed to be an electro-negative metal. It is true that some forms of carbon are highly inflammable, but are they more so than Graham's hydrogenium? Graphite at ordinary temperatures is far from combustible, and when it burns, or when the diamond burns in oxygen gas, wrought-iron will burn also. No one doubts that iron is a metal, yet one of its purest forms is pyrophoric, taking fire and burning on contact with the atmosphere. To associate graphite with sulphur and phosphorus is to place it, a good conductor of electricity, side by side with the very enemies of travelling magnetism. For how many ages was molybdenite undistinguished from graphite, and who is there now that can instantly distinguish the one from the other? It is true that molybdenite is a sulphide of molybdenum, and graphite a pure allotropic form of carbon, but may there not be one more form of carbon? There is no substance in nature more readily recognised as a metal by the unlearned than graphite; to this day it is impossible to take from it the improper title of black-lead. The experiments of Sir Benjamin Brodie with graphite, his discovery of graphic acid and its combination with ammonia (*graphate of ammonia?*) afford another analogy; for molybdenum has its molybdic acid, and what chemist is there that is not familiar with *molybdate of ammonia?* I have found that contact of native graphite with an electro-positive amalgam and water or acid, produces the same reaction and effervescence as when a negative metal occupied the place, but an amalgam did not seem to form.

It would appear that the division of elements into metals and non-metals is as arbitrary as any other absolute division or classification in science; for though the extremes may readily be distinguished,—as gold from fluorine,—the means often approach each other in appearance and in properties.

Besides forming amalgams of steel and cast-iron, I have

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succeeded in combining mercury directly with crystalline octahedral iron ore (*magnetite*), and with other ores and some furnace products. The loadstone exhibited, coated with mercury, is from the Adirondack mountains. Red fossiliferous hæmatite ore from Georgia is also readily amalgamated. Bog-iron has so far resisted mercury, save one specimen from the state of Florida, which appeared to receive it slightly. The *slag*, &c., of the Colorado gold-smelting furnaces may also, by means of the compound amalgam, be coated with mercury. Magnesium may be amalgamated with the aid of zinc-amalgam and chlorhydric acid; much heat is evolved, sufficient indeed to burn the hand if laid upon it. Bisulphide of carbon, treated with the compound amalgam, is decomposed; sulphides of the alkaline metals result, while another portion of sulphur combines with the mersury, forming true vermilion. Carbon separates in form resembling graphite.

The practical applications of these discoveries are numerous. As mercury dissolves iron and its ores, and finally separates the metal from its impurities of silicon, sulphur and phosphorus, it may prove possible to prepare an iron, nearly as pure as that reduced by hydrogen, for medicinal purposes, by distilling the mercury from the amalgam. In accordance with the laws announced, it is evident that plates of amalgamated zinc or iron are superior to plates of copper in effecting the amalgamation of gold, especially if they be treated with proper acid solutions while the stamped ore is being run out over them. Potassium and sodium amalgams are undoubtedly more effective, but can hardly compete with amalgamated zinc-plates in cheapness.

A great philosopher has said that the results of all experiments should be recorded, nothing being worthless that adds to man's knowledge of the properties of matter. It is my hope that the experiments described, and suggestions here thrown out, may not be altogether valueless.

ON THE ZIRCONS OF CEYLON.*

By M. H. COCHRAN, F.C.S.

THE natural silicates of zirconium have of late attracted great attention among chemists by reason of the researches of Messrs. Sorby and Forbes, and on account of the discovery of a supposed new earth associated with zirconia in these minerals.

Many chemists have held the opinion that zirconia was in reality a mixed earth. Svanberg in 1845 announced the discovery of a new element, to which he gave the name norium, in zircons and jargons from Ceylon and Siberia, but as he did not make known the results of any further researches on it, the existence of norium was rendered doubtful.

Mr. Sorby, in 1869, announced the discovery, by means of the micro-spectroscope, of an earth having a totally different absorption spectra from that of any known element, and he succeeded in separating the new earth from zirconia. Mr. David Forbes, at Mr. Sorby's request, made a chemical analysis of Ceylon jargon, and he also succeeded in separating the other earths from zirconia by taking advantage of the insolubility of zirconium chloride in concentrated hydrochloric acid.

Having through the kindness of a friend obtained seven small specimens of jargon and zircon from different localities, I analysed them by the same process which Mr. Sorby adopted.

The finely-powdered mineral was fused thoroughly with a mixture of equal parts of carbonate of soda and carbonate of potash until the silicate was decomposed, a little caustic potash being dropped into the centre of the fused mass towards the end of the process. This was then treated repeatedly with boiling water, and the silica estimated in the solution in the usual way. The residue contained all the zirconia; it was tested carefully for silica, but was found completely free from it. It was then once more evaporated to dryness with hydrochloric acid, and the residue treated repeatedly with concentrated hydrochloric acid, which dissolved out a small quantity of sesquioxide of iron, and also the other earth accompanying zirconia, to which Mr. Sorby gives the name jargonia. The residue after this treatment was dissolved in water, and the zirconia precipitated by ammonia and weighed, and called A.

To the hydrochloric acid solution ammonia was added, then tartaric acid in excess; a portion of the precipitate at first formed was dissolved, but a quantity remained undissolved; this was washed, dried, ignited, weighed, and marked B; when examined with the micro-spectroscope it was found to have a spectra different from that of any known element.

Ammonia was added to the tartaric acid solution, then sulphide of ammonium, when, after the lapse of some days a precipitate of sulphide of iron was formed; this was collected, converted to sesquioxide of iron, and weighed. After separation of the iron the solution was evaporated to dryness in a platinum basin and ignited strongly for some time, when a residue was left, which appeared to be a third earth; this was marked C. Mr. Forbes's analysis yielded the following numbers:—

Silica	33·61 per cent.
Zirconia A.	46·12 ,,
,, B.	7·64 ,,
,, C.	12·62 ,,
Sesquioxide of iron ..	0·24 ,,
	100·00

I adopted exactly the same method, but except in one instance everything was precipitated at the stage A, and I could not succeed in obtaining any other earth than zirconia.

The first specimen examined was a jargon from Ceylon; it was almost colourless. 0·9320 grm. yielded on analysis—

Silica	0·316
Zirconia..	0·604

Or, when calculated to per cent—

Silica	33·90
Zirconia..	64·80

It contained no iron.

The second specimen was a pale yellowish hyacinth, also from Ceylon. 0·733 grm. gave—

Silica	0·241, or 32·87 per cent.
Zirconia	0·471, or 64·25 ,,
Ferric oxide.. ..	0·015, or 2·04 ,,

The third was a Norwegian zircon, and was of a dark brownish yellow colour. 0·701 grm. gave—

Silica	0·228, or 32·53 per cent.
Zirconia	0·449, or 64·05 ,,
Ferric oxide.. ..	0·020, or 2·85 ,,

The fourth specimen was an almost colourless Ceylon jargon. 0·655 grm. gave—

Silica	0·2165, or 33·05 per cent.
Zirconia	0·4370, or 66·71 ,,

It had only the merest trace of iron.

The fifth was also an almost colourless jargon from Ceylon. 0·503 grm. gave—

Silica	0·1710, or 33·86 per cent.
Zirconia	0·3245, or 64·25 ,,
Ferric oxide ..	0·0055, or 1·08 ,,

The sixth sample was a Norwegian zircon. It had a dark brownish yellow colour, and was almost opaque. 0·5 grm. gave—

Silica	0·1680, or 33·61 per cent.
Zirconia	0·3200, or 64·40 ,,
Ferric oxide	0·0045, or 0·90 ,,

* Read before the Glasgow Philosophical Society.

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The seventh specimen was a Ceylon jargon, and it was perfectly clear and transparent. 0·488 grm. gave on analysis—

Silica	0·1650, or 33·81 per cent.	
Zirconia A	0·2835, or 58·29	,,
,, B	0·0390, or 8·03	,,

It contained a faint trace of iron. The substance marked zirconia B was examined with the microspectroscope in the manner described by Mr. Forbes in the CHEMICAL NEWS, April 30, 1869; but was entirely unsuccessful in detecting any peculiar absorption-bands. In appearance, and apparently in all its properties, it was exactly the same as the zirconia A. From my examination, therefore, I am inclined to doubt the existence of the so-called jargonia, as I believe the zirconia A and B to be identical.

EXPERIMENTS ON DISINFECTANTS.

A SPECIAL commission was appointed by the Academy of Sciences, at Paris, to study the different means of disinfecting those localities which, during the siege, had been appropriated to persons afflicted with contagious diseases. Its report furnishes some useful guides to the selection and the application of disinfectants.

The report assumes, in the first place, the germ theory of infection.

Placing in the same rank chlorine and the hypochlorites, which effect a veritable disinfection by decomposing the infected gases, and carbolic acid, of more recent application, which prevents or arrests putrid fermentation by destroying the vitality of the principal living agents of the fermentation, the commission compared the effects obtained with those which one might expect from very energetic chemical agents, capable of burning up or otherwise destroying the germs.

The commissioners agreed that the very first place among destructive agents which can attack and destroy infectious germs, should be assigned to hyponitrous acid. Great precaution should be exercised, however, by those employing the very dangerous nitrous vapours. Doors, windows, and the fireplace, should be carefully sealed with gummed paper. The following are the proportions and the quantities of materials to be employed per 30 to 40 cubic metres:—Water, 2 litres; ordinary commercial nitric acid, 1500 grms.; copper turnings or shavings, 300 grms. Earthenware vessels of 8 to 10 litres capacity are employed, one for 30 to 40 cubic metres of space. The exit door is carefully sealed, and the room exposed to the fumes for 48 hours. The person who opens the room must be protected by some means, such as the apparatus of Galibert. Carbolic acid is much more easily applied, is less dangerous and expensive, and seems to offer guarantees of quite equal efficacy, founded on experimental evidence. It is best employed by mixing with sand or sawdust, in the proportion of 1 kilo. of acid and 3 kilos. of the inert material. The mixture is placed in earthen pots, as above, and under the same conditions. Carbolic acid, diluted with 25 to 30 times its weight of water, was found very useful in sprinkling daily the floors and the bedding of sick chambers.

An interesting case is cited, where chlorine and the hypochlorites were powerless to destroy or to transform into inodorous products the gases given off by the bodies at the Paris Morgue during the heat of summer. Only one course remained, and that was to destroy the active sources of the gaseous products. This was accomplished by dissolving a litre of liquid carbolic acid in the reservoir of 1900 litres fresh water, which served to sprinkle the bodies. The suppression of putrid fermentation was complete.

It has been stated, by M. Devergie, that water containing only the $\frac{1}{2000}$th part of its weight of carbolic acid sufficed for the disinfection of the dead-house, during the hottest weather, when it contained from six to seven bodies.

The following is the method of fumigating, with chlorine, the linen, mattrasses, and other bedding, according to the latest recommendations of M. Regnauld:—

In a strong canvas bag, of 1 litre capacity, introduce 500 grms. chloride of lime (a mixture of hypochlorite of lime and chloride of calcium, usually at 100°); then sew up the bag. The latter is then placed in an earthen pot containing 1 litre of common hydrochloric acid, sp. gr. 1·15, and 3 litres of water; as soon as the chloride comes in contact with the acid the room is closed, and the goods are left exposed to the chlorine fumes for 24 hours; the room is afterwards ventilated during 48 hours. Ten earthen vessels, as above, disengage 500 litres of chlorine, sufficient to disinfect 20 to 25 mattrasses more or less contaminated.—*Le Bulletin du Musée de l'Industrie.*

ON THE PURIFICATION OF SUGAR SOLUTIONS FOR THE OPTICAL SACCHAROMETER.

By P. CASAMAJOR.

IN the *American Chemist*, April, 1871, p. 378, is an article by Dr. Stammer, taken from the *Sugar Cane*, on the use of animal charcoal in purifying saccharine solutions for polarimetric analysis. The conclusion which is drawn from the experiments detailed in the article is that animal charcoal absorbs sugar from its solutions, and cannot therefore be used for clarifying saccharine solutions for analysis. This conclusion is certainly interesting in a scientific point of view, but hardly less so in its practical bearings to the sugar manufacturer and refiner. It is a matter of such importance that it cannot be accepted without incontrovertible proof, even if supported by such authority as the name of Dr. Stammer.

After making a great many experiments, I am in a position to state that *animal charcoal does not absorb sugar from its solutions* in the same manner as it absorbs colouring matter, salts of lime, magnesia, iron, &c.

The proof of this I have obtained by eliminating with care every source of error, and repeating the experiments several times with different sugars.

I have proceeded as follows:—In the first place, a solution was used of a sugar light enough to give a liquid fit for the saccharometer with acetate of lead, but without using animal charcoal. This solution was placed in the saccharometer, and the result obtained noted.

This same solution was afterwards filtered over animal charcoal containing 3·8 per cent of water. The saccharometer indicated 2 per cent less of sugar.

Another portion was filtered over animal charcoal containing 8·8 per cent of water. The saccharometer indicated a loss of 5 per cent.

For instance:—16·35 grms. of a light-coloured sugar was dissolved so as to occupy 100 c.c. The solution, after treatment with subacetate of lead, was of a slight yellow colour. The saccharometer indicated 90 per cent. With the portion filtered over animal charcoal containing 3·8 per cent of water, the saccharometer indicated 88 per cent. With the portion filtered over animal charcoal containing 8·8 of water, the saccharometer indicated 85 per cent. These results show that the presence of water in the bone-black will affect the strength of the solution.

The next step was to filter the saccharine solution over perfectly dry animal charcoal. This was obtained by heating animal charcoal for over two hours over a lamp, at 350° F., and *throwing the black, while hot, into a hot and dry bottle.* Immediately afterwards the bottle was hermetically closed.

When this dry black is used no loss of sugar is shown by the saccharometer. There cannot be an error in this,

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as the experiment was repeated several times with the same uniform result.

It has been stated that the conclusion of Dr. Stammer is, that animal charcoal absorbs sugar from its solutions. If, however, we examine attentively the table from which this conclusion is drawn, we shall notice that the differences between the percentages of sugar, before and after filtration, are very small, varying from 0·2 of 1 per cent to 0·6 of 1 per cent, except in cases where bone-black was used in large quantities, twice or three times as much as in the greater number of cases. The time of contact of the bone-black with the saccharine solution does not seem to have had any influence on the pretended absorbing power of animal charcoal for sugar. These times of contact vary from 3 hours to 24 hours, but the pretended quantities of sugar absorbed vary independently of these times. The variations when they occur are less than ½ per cent. Nobody who has experience in tests by the optical saccharometer needs to be told that such variations must necessarily take place, even on testing the same solution twice in succession, particularly if it is not perfectly colourless.

In examining the two tables, it seems strange that there is so little difference in the comparative results, as the experiments of Table 1 were made with animal-black that had been heated at 230° F., and those of Table 2 with animal-black that had been heated at 350° F. Bone-black heated at 230° F. does not lose all its water. The water remaining in the black, heated at 230° F., will certainly affect the strength of the solution, and produce an apparent absorption; while bone-black, heated long enough at 350° F., loses all its water, and will not affect the strength of the solution. That the portions mentioned as absorbed are very nearly alike in both tables, except when larger quantities of bone-black are used, shows that the bone-black was not kept perfectly dry.

It is of the utmost importance to use bone-black that has been *kept dry in a closed bottle*. If the bone-black is allowed to cool in the open air it very quickly absorbs moisture. If used hot it increases the temperature of the solution, and by expansion decreases the percentage shown by the saccharometer. As to putting it in the solution hot and allowing it to cool, if left for several hours, as in some of the tests in these tables, there is great danger of losing sugar by fermentation.

Instead of bone-black I use a process, to obtain colourless saccharine solutions, which has answered with all grades of sugar, and which certainly does not take any additional time, or give any additional trouble. This process is founded on the observation that the facility and perfection of clarifying a solution of sugar by subacetate of lead seems to depend on the quantity of mineral salts contained in the sugar. Thus many very dark inferior sugars, such as Manillas, will give solutions which are easily clarified by subacetate of lead, producing at the same time a dense precipitate. Such sugars give, on incineration, a large quantity of ashes. Other saccharine products, particularly those that have been filtered over bone-black, are not very dark, but subacetate of lead acts on them imperfectly, giving a slight precipitate which stops up the pores of the filters.

Acting on the above observation, I add to saccharine solutions soluble salts capable of giving dense precipitates, with subacetate of lead. I have used at different times chloride of sodium, sulphate of soda, phosphate of soda, and acid phosphate of lime, and have found them all equally effective. Other chlorides, sulphates, phosphates, iodides, &c., will doubtless give the same result.

The soluble salt is added by throwing a pinch of it on the sugar, and dissolving by water afterwards, or by putting in a few drops of a solution of the salt.

The results obtained are very satisfactory, as the solutions are quite, or nearly, colourless, whatever be the kind of sugar treated. A secondary advantage is, that the precipitate is very dense and easy to filter, while some of the sugars without the addition of the salts filter very slowly.

By a succession of experiments I have ascertained that the addition of the salts mentioned above does not affect the saccharometric percentage of the solution.

In connection with the subject of purifying sugar solutions for the saccharometer, there is an important fact, discovered in this laboratory, by Mr. Henry O. Havemeyer. When in saccharometric tests we are obliged to invert, as in tests of molasses, melados, and very low sugars, the hydrochloric acid used produces such a red colour that the solutions are not fit for the saccharometer unless we are careful not to heat them above 68° C., and to cool them as soon as possible afterwards. The inversion is often imperfect under these circumstances, and the safest way is to invert again until no change is shown by the saccharometer. If this is repeated, the red colour will appear even if the solution is not heated above 68° C., and is cooled quickly.

The important fact mentioned above is, that the addition of a small quantity of protochloride of tin will prevent the formation of the red colour, even if the solution is heated above 70° C., several times, until no variation is shown by the saccharometer.—*American Chemist.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 20th, 1872.

DR. FRANKLAND, F.R.S., President, in the Chair.

THE minutes of the previous meeting having been read, Messrs. Patchett and G. B. Longstaff were formally admitted Fellows of the Society. The donations were then announced, and the names of Messrs. Arthur Willis and Robert Symington Grieve Paton read for the first time: for the third time—Messrs. John Emilius L. Shadwell, M.A., Walter Weldon, Walter Stewart, jun., John Ferguson, M.A., Charles Armbruster, George J. Snelus, and R. Wormell, M.A., B.Sc., who were then ballotted for and duly elected.

The PRESIDENT said the Fellows might perhaps recollect that, about two years ago, the Society had agreed to make grants not exceeding fifty pounds for the promotion of original research; and he now had to announce that Mr. Hyde Hills had given the sum of ten guineas for the same object, and generously offered to give other ten guineas for each ninety guineas subscribed up to five hundred pounds. He need scarcely ask the Fellows to thank Mr. Hills for his liberality in endeavouring to encourage original research. He would now ask Mr. Deacon to deliver his lecture on his "*Process for the Preparation of Chlorine.*"

The Lecturer said that about two years ago, at Liverpool, he had given an account of his process for the preparation of chlorine from a heated current of hydrochloric acid mixed with air, which since then had been the subject of a great amount of research, with the object of ascertaining how this could be effected continuously, readily, and at the smallest cost. This problem may be resolved into the following:—

1. As to the most suitable active or catalytic substance.
2. Whether the mass or the surface of the substance was the active agent.
3. As to the effect of temperature.
4. As to the best arrangement of the substance.
5. As to the effects produced by variation in the velocity of the current of gas.
6. As to the effect of various proportions of air or oxygen and HCl.

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He had observed that the heated mixture of hydrochloric acid and oxygen or air does not yield chlorine, unless it is in the presence of some substance capable of being attacked by the hydrochloric acid, amongst which the copper compounds were eminently active.

Sulphate of copper was fixed upon for economic reasons: and almost all the experiments mentioned in his lecture had been made either with the pure sulphate or with pumice-stone or fragments of clay saturated with it. In experimenting, two clay tubes were generally employed, of different bores, glazed externally, and coated internally with sulphate of copper, placed side by side, and passing through the cork of a glass tube sealed at the other end. The mixed gases, on entering, first traversed the glass tube, and then passed out by the clay tubes. In the more recent experiments this apparatus was placed in a thick massive iron tube, heated externally by a furnace, so as to maintain a uniform temperature. This was measured by the change in electrical resistance of a fine platinum wire, and also by a mechanical pyrometer. The mixed gases were contained in gas-holders worked with strong sulphuric acid, both the amount of hydrochloric acid passed and the amount of chlorine produced being ascertained by passing the gases into a solution of caustic soda.

The Lecturer then explained the numerous diagrams and tabulated results of experiments with which his discourse was illustrated, from which it would appear that there is a certain comparatively small range of temperature, between the critical limits of which the percentage of hydrochloric acid decomposed varies greatly, and that this is not the same for the chloride as for the sulphate of copper, being higher for the latter, although it is the same whether solid sulphate of copper be used or merely pieces of brick saturated with it. This shows that the action is essentially a surface action. It is, however, remarkable that in experiments on a large scale this temperature is invariably lower than in the laboratory experiments, usually 100° or 150°; also, that when the mixed gases are passed through a series of parallel tubes, an increased velocity in the flow of the gas yields only about one-third the increase of the amount of chlorine produced that an irregular porous surface does under like circumstances.

From the results of all the experiments contained in the tables, the speaker inferred—

1. That with the same mixture of gases, at the same temperature, the amount of hydrochloric acid decomposed by the aid of a molecule of the copper salt, in a given time, depends upon the number of times the molecules of the mixed gases are passed through the sphere of action of the copper salt.
2. That in long tubes of the same diameter the number of opportunities of action in the same time are nearly the same at all velocities.
3. That in long tubes of different diameters the number is the same when the velocities of the currents of gas are in inverse proportion to the square of the diameters.
4. That in porous masses the opportunities of action increase with increased velocities, in nearly direct proportion.
5. That, other conditions remaining the same, the percentage of hydrochloric acid decomposed varies with the square root of the proportionate volume of oxygen to hydrochloric acid.
6. That the $CuCl_2$ formed bears no definite proportion to the amount of chlorine produced.
7. That as the sphere of action includes molecules not in contact with the copper salt, therefore hydrochloric acid must be decomposed under circumstances where the union of either element with the copper salt is impossible.

The President said he need scarcely ask them further to record their thanks to the lecturer, for the clear and comprehensive account he had given them of his numerous and interesting experiments on the mutual action of hydrochloric acid and oxygen in the presence of salts of copper. The process for preparing chlorine, at present used, was essentially clumsy and unscientific; the hydrochloric acid given off from the salt cake was first dissolved in water, and then treated with manganic peroxide in order to liberate the chlorine, giving rise, at the same time, to a large amount of waste products, which were thrown into our streams and polluted them. As especially interested in our rivers, he sincerely hoped the process would prove a commercial success.

Dr. Williamson said he would like to ask a question or two for his own information. He understood that the mixture of air and hydrochloric acid was heated before being passed into the decomposing chamber; was it cooled again before it went into the chambers containing lime for the preparation of chloride of lime, and was the undecomposed hydrochloric acid previously removed by washing?

Dr. Debus would like to know whether the sulphate of copper was found to be unaltered after having been exposed to the action of the mixed gases for a considerable time, and also whether, when he used straight tubes with the mixed gases passing through at different velocities, the gas in both instances had attained the same temperature when it came in contact with the sulphate of copper.

Mr. Stevenson remarked that he had no practical acquaintance with Mr. Deacon's process; but he thought that if the old process continued to be used, we possessed a great advantage in Mr. Weldon's method for revivifying the manganese, so that, in this revolutionary period of the manufacture, we had the benefit of both processes.

Dr. Voelcker said the lecturer had made an allusion to the action of chromium on the mixed gases in the early part of his lecture; would he, perhaps, kindly explain what was its especial peculiarity?

Dr. Gladstone observed that many interesting points started up in one's mind in connection with this subject, and he should like to know more fully why the lecturer believed the sphere of action to include molecules not in contact, and that the decomposition was not due to direct chemical action. It appeared to him that it was unnecessary to suppose the cause to be the mechanical striking of the molecules of the gas against the sulphate of copper surface, in their passage through the apparatus, and therefore depending on the flow; for it must be remembered that, when a gas was mechanically in a state of rest, the molecules composing the gas are in a state of motion, and that when we heat that gas this rate of motion of the molecules amongst themselves varies, although the gas is still mechanically at rest.

Mr. Deacon replied that it was one thing to express clearly what one had carefully thought over, and another to answer, off-hand, questions that embraced a wide field of enquiry; moreover, he had come there to speak simply on the scientific aspect of his subject, and he thought it would save the time of the Fellows present, and avoid going over old ground, if they would permit him to put aside all technical questions, and reply only to those which had a scientific interest.

In the first place, there is a definite range of temperature where chlorine is freely formed, but no chloride of copper; although at a higher temperature, the sulphate of copper is partly converted into chloride. This only applies to pure sulphate of copper, which, even after the action had been continued for six months, contained but mere traces of chlorine. In the presence of clay, however, the sulphate of copper is decomposed, and chloride formed, probably owing to its containing some base which combines with the sulphuric acid.

In the case where the exterior glass tube contained two clay tubes of different diameters, the gas coming in contact with the copper salt certainly had the same temperature, although moving with different velocities.

With regard to his allusion to chromium, he had ex-

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pected—from the well-known oxidising power of chromic acid—that it would have been very active, but, on the contrary, he had found that it was reduced to oxide of chromium, which is one of the most inactive substances.

With respect to the theory he had laid before them, without vouching for its correctness, he could say that it was the only way he knew of accounting for the results he had obtained.

After a vote of thanks to the lecturer, the meeting adjourned over the recess.

CORRESPONDENCE.

MANUFACTURE OF SULPHATE OF AMMONIA—PROPOSED ASSOCIATION OF MANUFACTURING CHEMISTS.

To the Editor of the Chemical News.

Sir,—Can some reader of the Chemical News tell me whether gas-works ammoniacal liquor is distilled anywhere in England at the present day on the continuous and economical principle of Coffey's Still? If so, a brief description of the apparatus and results obtained in working would, I am sure, interest the large number of your readers connected with the manufacture of sulphate of ammonia,—certainly the great majority of whom work on the more wasteful and costly plan of boiling off in charges by fire or steam, or of evaporation to crystallising-point after saturating with acid. I know a works where plant is just about to be erected for thus evaporating 90,000 gallons per week, at an estimated weekly expenditure of 50 tons of coal!

I have been very much struck for some time back with the extraordinary isolation with which we English chemical manufacturers surround ourselves. I have repeatedly discovered gentlemen within a few miles of the works with which I am connected, blundering away at problems which have been settled here years before, and the solution of which we should have been most happy to show them, had they had the courage to ask our experience in the matter. Similarly, I confess to have found ourselves on the wrong side of methods and plans which others had elaborated, which they had no special interest in keeping secret, and the earlier adoption of which by ourselves might have saved years of time and hundreds of pounds of expense. I am persuaded that the secretiveness and isolation from our neighbours which, as manufacturers, so many of us deem it necessary to keep up, loses us vastly more than we would gain by a frequent interchange of ideas and experiences.

Let none of your readers imagine me a disciple of Mr. Macfie. I am, and always have been, a warm advocate of a Patent Law; and while I believe that there are numberless auxiliary methods and plans of a kind which manufacturers never dream of patenting (which they would be glad to exchange and reciprocate with others), I consider that nothing would so much promote the introduction of valuable patents as the periodically bringing together, for mutual interests, of the great body of manufacturing chemists.

Let it not be forgotten that the large-souled recognition of this truth by the iron-masters, in the formation of their new Iron and Steel Institute, has led directly to the adoption of the invaluable Danks furnace.

I submit to your readers that the time has come for an Association of Manufacturing Chemists, holding an annual gathering, at which the manufacture of at least the great staple, sulphuric acid, might be discussed, scientific and technical papers of general interest read, and such questions considered as the transfer of chemical works from the supervision and control of illiterate Local Board inspectors to that of the intelligent and scientific staff administering the Alkali Act. Everybody knows that the two great results of that Act have been, (1) to deliver alkali-makers from the miseries and heart-burnings of nuisance-making; (2) to compel them to make money by condensing a corrosive acid. I ask whether a similar result in other branches of manufacturing chemistry would not be infinitely preferable to the state of siege (in fact, in some districts, absolute prohibition of manufacture) now kept up by Local Boards. Other matters of daily-increasing importance, such as the rapid growth and scientific treatment of chemical manufacturing on the Continent, might be discussed with immense advantage.

Trusting some of your readers will take up other phases of the question, and that the matter will not be allowed to drop till a strong national association has been formed,—I am, &c.,

Frank.

June 22, 1872.

THE ATOMIC HYPOTHESIS.

To the Editor of the Chemical News.

Sir,—After the very positive assertions made by Mr. Atkinson (without accompanying evidence) in Chemical News, vol. xxv., p. 273, it may appear somewhat rash to continue the discussion; but with your permission I would offer a few points for consideration.

According to J. S. Mill "an hypothesis is any supposition which we may make (either without actual evidence, or on evidence avowedly insufficient) in order to endeavour to deduce from it conclusions in accordance with facts which are known to be real." And he goes on to say that an hypothesis for verification requires it to be shown, in the first place, that from it the known facts may be deduced; and, in the second place, that *they can be deduced from no other.* Now, even if the first requisite be admitted in the case under discussion, I am not aware the second has been attempted, so it would seem that the atomic hypothesis is still unverified.

Mr. Atkinson's argument, that the law of multiple proportions cannot exist apart from the atomic hypothesis because it is not in exact accord with experimental results, appears to me to be equally opposed to the hypothesis, unless the latter can be supported by *extra chemical evidence*; for, as far as chemistry is concerned, it depends on precisely the same kind of experimental results, and is in no closer accord with them than is the law of multiple proportions. Indeed, I might have said on *supernatural* evidence, for all natural laws have experimental bases.

Turning to the historical side of the subject, I think it may be shown that Dalton discovered the law of multiple proportions before he devised the atomic hypothesis. In his earliest chemical memoir, in 1802, he says "the elements of oxygen may combine with a certain portion of nitrous gas, or with twice that portion, but with no intermediate quantity." His first table of atomic weights was read in 1803, a year later, and is most clearly based upon experiment. His biographer, Dr. Henry, is led to conclude that "the discovery of the law of multiple proportions was, in the order of mental operations, the immediate *antecedent* of the atomic theory of chemical combination." Richter, between 1789 and 1802, constructed a table of reciprocal proportions, and Dalton is said to have acknowledged that this suggested to him the speculations which led to the atomic hypothesis. This has been denied; but, in any case, Richter's law preceded the hypothesis.

It is instructive to note the views of two such thinkers as Davy and Faraday on this question. In Thompson's "History of Chemistry," it is stated that Thompson first, and then Thompson and Wollaston together, tried in vain to induce Davy to accept the hypothesis, but that Davies Gilbert afterwards succeeded. Yet in 1811 Davy writes:—"It is not on any speculation upon the ultimate

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particles of matter that the true theory of definite proportions must ultimately rest;" and in his works he refused to employ the term "atom," preferring "proportion."

In 1853, Faraday writes:—"As to the little solid particles which are by some supposed to exist independent of the forces of matter . . . as I cannot form any idea of them apart from the forces, so I neither admit nor deny them. They do not afford me the least help in my endeavour to form an idea of a particle of matter. On the contrary, they greatly embarrass me." "The notion of a solid nucleus without properties . . . becomes to me hypothetical, and what is more, a very clumsy hypothesis."

In the same year, Liebig, while supporting the atomic hypothesis, said:—"Dalton's atomic theory was a product of the age, and sprang forth in his mind, as a *consequence* of the discovery of chemical proportions or equivalents."

The rapid advance of chemistry where the atomic hypothesis is accepted would furnish a valid argument in its favour, but that, as I believe it is due not to the hypothesis at all, but to the application of the several laws of combination and the use of symbols, all which are susceptible of proof quite independently of the hypothesis.

I should like to say a little about the question of isomerism, but, in view of the length of this letter, will content myself with remarking that it appears to me that the explanation offered by the atomic hypothesis involves three assumptions—first, that matter is ultimately composed of atoms; second, that in isomeric bodies the constituent atoms are differently arranged; and third, that this difference of arrangement is the cause of the observed difference of physical properties. As far as I know, saying nothing of the first of these assumptions, no evidence whatever has been brought forward in support of the second and third. The so-called explanation is about as real as that which accounts for the action of manganese dioxide in reducing the temperature of decomposition of potassium chlorate, by saying that it is catalytic.

Apologising for so great a trespass on your space,—I am, &c.,

WILLIAM THORP, JUN.

June 19, 1872.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, June 3, 1872.

This number opens with a short account of the mission which M. de Quatrefages and E. Becquerel have performed as representatives of the Academy, at the centenary celebration of the Royal Belgian Academy of Sciences, recently held at Brussels. It appears that the French delegates are highly pleased with their reception, and intend to give a more detailed account of the proceedings at which they have assisted.

The following papers relating more particularly to chemistry are published in this number:—

Formation of Acetylen by Means of Electric Discharges not attended with Sparks (Décharge Obscure).—Dr. Berthelot.—After first referring to the modes of formation of acetylen in general, the author states that he also obtained this body by applying Houzeau's apparatus for making ozone, passing the electric current through hydrogen saturated with vapours of hydrocarbons; but the quantity of acetylen thus formed is very small, and the author ascribes this to the fact that the electric discharge attended with sparks has a *far higher temperature* than the dark (non-luminous) discharge, and that, while acetylen is not decomposed by a high temperature, ozone cannot be formed under the latter condition.

Conversion of Ethyl-Naphthalin into Acenaphthen.—Drs. Berthelot and Bardy.—Ethyl-naphthalin is a complex hydrocarbon, discovered by Drs. Fittig and Remsen, by means of the reaction of bromated naphthalin, hydriodic ether, and sodium. Ethyl-naphthalin, $C_4H_4.C_{20}H_8$, differs from acenaphthen in having two equivalents more of hydrogen, the formula of acenaphthen being $C_4H_2.C_{20}H_8$. This last-named body was first discovered by the authors, having been prepared by causing ethylen or acetylen to react at red heat upon naphthalin; acenaphthen occurs ready formed in coal-tar. The methods of conversion of ethyl-naphthalin into acenaphthen are described by the authors at length: one of these methods consists in passing ethyl-naphthalin through a red-hot tube, this decomposition being elucidated by the formula—

$$C_4H_4.C_{20}H_8 = C_4H_2.C_{20}H_8 + H_2.$$

Another method is by the wet way—treatment with bromine and alcoholic potassa solution, at a higher temperature: this reaction—which, however, yields only a very small quantity of acenaphthen—is elucidated by the following formula:—

$$C_4H_3Br.C_{20}H_8 + KHO_2 = C_4H_2.C_{20}H_8 + KBr + H_2O_2.$$

Ethyl-benzine has been by the authors converted, by the last-mentioned method, into styrolen.

Although not strictly belonging to chemical subjects, we quote the titles of the two following memoirs:—

Observations on Chlorosis and Anemy as affecting Men and Women, a Communication made in consequence of Boussingault's Memoir on the Iron contained in Blood and Food.—Dr. Bouillaud.—A very important physiologico-pathological paper.

Note on the Distribution of the Water of the River Rhone, at Nimes.—A. Dumont.—This memoir contains a condensed description of an ingenious mode of supplying Nimes with water from the River Rhone, which water is naturally filtered (*filtration naturelle*), while passing through the subterranean aqueduct, the largest now known to exist. This city, it should be remembered, was in ancient times copiously and magnificently provided with pure water by the aqueduct—now partly in ruins—known as the *Pont du Gard*, and destroyed by the Vandals.

La Revue Scientifique de la France et de l'Etranger, June 15, 1872.

This number contains no papers relating to chemistry.

On Animal Heat.—Dr. C. Bernard.—These excellent lectures are continued, and deserve attention. This portion, which is illustrated with woodcuts, treats on the influence of the nervous system, and more particularly the sympathetic system upon circulation, and collaterally upon animal heat.

Bulletin de la Societe Chimique de Paris, Vol. 17, No. 4, February 15, 1872.

From the *procès-verbaux* of the meeting of this Society referred to in this number, we quote the following particulars:—

Chlorides of Sulphur.—M. Maumené.—The author states that he has obtained by the action of chlorine upon sulphide of carbon, two peculiar chlorides, viz., (1), $CSCl_8$, boiling at 47°; (2), CSCl, boiling at 70°. Dr. Guignet observes that sulphide of carbon is very readily acted upon by chlorine, even when the latter is left in contact with the former in the state of solution, as chloride of carbon and chloride of sulphur are then formed. When vapours of sulphide of carbon and chlorine are passed through a red-hot tube, tetrachloride of carbon is abundantly formed; the same obtains when sulphide of carbon is treated with perchloride of antimony, in which case a smaller quantity of by-products are obtained.

The following original memoirs are contained in this number:—

Temperature at which the Spontaneous Crystallisation of a Supersaturated Solution of Sulphate of Soda takes place.—L. C. de Coppet.—We regret that the great length of this memoir, and the necessity of reproducing several tabulated formulæ essentially required for the proper understanding of the subject, render it unsuitable for useful abstraction, notwithstanding its high intrinsic merits.

On Sexbasic Saccharate of Lime.—H. Déon.—When tribasic saccharate of lime is treated with alcohol the sexbasic saccharate is obtained by elimination of one-half of the sugar, exactly in the same way as by treatment of the monobasic saccharate with alcohol yields the bibasic saccharate; while the monobasic and tribasic saccharates contain water, the bibasic and sexbasic saccharates contain none. The reactions are thus analogous, and may be expressed by the following formulæ:—$C_{12}H_{11}O_{11}6CaO$, derived from—

$$2(C_{12}H_{11}O_{11}3CaO + HO)C_{12}H_{11}O_{11}2CaO,$$

derived from $2(C_{12}H_{11}O_{11}CaO + HO)$; when sexbasic saccharate is combined with two equivalents of sugar, bibasic saccharate is obtained,—and when two equivalents of sugar are added to tribasic saccharate, monobasic saccharate is formed.

Black Colouring Matter contained in Native Bitumen.—MM. Le Bel and A. Muntz.—The authors have extracted from bitumen (native, as well as that obtained from tar) a black-coloured substance, insoluble in alcohol and ether, soluble in sulphide of carbon and chloroform, and fusing—without volatilising—at between 130° and 145°. This substance, which possesses very great colouring power,

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has been called asphaltene, and was found to consist chiefly of carbon and hydrogen. From an Egyptian bitumen the authors also obtained a similar body, but this was found to contain more oxygen, and, moreover, a notably large proportion of ash.

No. 5, March 1, 1872.

This number contains the following original papers and memoirs:—

Acetic Ethers of Dulcite and Dulcitan.—G. Bouchardat.—The following compounds are described:—Diacetic dulcite—

$$C_{12}H_8(H_2O_2)_4(C_4H_4O_4)_2,$$

a solid crystalline body, soluble in water, nearly insoluble in alcohol and in ether, fuses at 175°, is partly decomposed by boiling water, also by alkaline solutions; hexacetic dulcite, $C_{12}H_8(C_4H_4O_4)_6$, also a solid crystalline compound, fusing at 171°, sublimable at 250° in an atmosphere of carbonic acid, nearly insoluble in cold water and in cold alcohol and ether,—hot water and weak alkaline solutions decompose this compound; pentaceto-monochlorhydric-dulcite—

$$C_{12}H_8(C_4H_4O_4)_4HCl,$$

is a solid crystalline compound, almost insoluble in all neutral solvents, while at the boiling-point of the same the compound is decomposed into pentacetic dulcite and hydrochloric acid,—boiling acetic acid converts it into hexacetic dulcite; pentacetic dulcite—

$$C_{12}H_8(H_2O_2)(C_4H_4O_4)_5,$$

fuses at 165°, sublimes at 250°; diacetic dulcitan—

$$C_{12}H_4O_8(H_2O_2)_2(C_4H_4O_4)_2,$$

is an amorphous, viscous, bitter-tasted substance, soluble in cold water, alcohol, and ether, and converted into tetracetic dulcitan, at 180°, by anhydrous acetic acid; tetracetic dulcitan—

$$C_{12}H_4O_8(C_4H_4O_4)_4,$$

is an amorphous resin-like substance, insoluble in cold water, very soluble in cold alcohol and ether.

Conversion of Aceton into Hydruret of Hexylen.—G. Bouchardat.—This paper treats on a compound produced by the action of nascent hydrogen upon aceton, viz., $2C_6H_6O_2+H_2=C_{12}H_{14}O_4$, which, according to the author, may be considered as dipropyl or hydruret of hexylen. To prove this a series of experiments have been made, the result of which confirms the author's opinion.

No. 6, March 15, 1872.

This number only contains the following original paper—

Solubility of Oxides in Alkalies.—M. Prud'Homme.—The main gist of this short notice is, that the addition of a small quantity of a salt of copper to a liquid containing a precipitate of sesquioxide of chromium (produced by ammonia in excess) re-dissolves that precipitate, which, however, reappears on boiling the liquid; inversely, oxide of copper is dissolved in potassa, in the presence of a salt of chromium, but at a higher temperature (above 100°) the oxide of copper is precipitated.

No. 7, April 1, 1872.

This number contains the following original papers and essays:—

Industrial Manufacture of Chlorine.—F. de Lalande and M. Prud'Homme.—Reserved for full translation.

On some Facts of Incomplete Oxidation as observed to take place in the Human Organism.—G. Daremberg.—The author relates, at length, a series of chemico-pathological researches, from which it appears that, in heart and lung diseases, the urea secretion decreases and that of uric acid increases.

On Ammoniacal Platinum Bases.—P. F. Cleve.—The fourth instalment of a lengthy monograph on this subject, this part being divided into the following sections:—Derivatives of platosemidiamine which contain aniline; derivatives of platosamine which contain aniline; derivatives of platosemidiamine which contain ethylamine; derivatives of platosamine which contain ethylamine.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 10, 1872.

This number contains the following original papers and memoirs:—

Non-Existence of Parathionic Acid.—C. Scheibler.—Referring to Erlenmeyer's researches, lately published on this subject, the author has proved the non-existence of this acid (first discovered and described by Gerhardt, in his *Traité de Chimie Organique*, as a body isomeric with ethyl-sulphuric acid) as far back as the year 1862, at which period the author made a communication on the subject at the meeting of the German philosophers and *savants*, held at Karlsbad, which communication was duly published in the *Tageblatt* of that meeting, pp. 66 and 80.

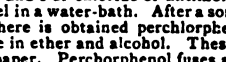
New Method of Synthesis of Diphenylketon.—M. Kollarits and V. Merz.—Benzoic acid and benzol were introduced, with anhydrous phosphoric acid, into a strong glass tube, which, having been sealed, was heated for a considerable time up to 180° to 200°. After treating the contents of the tube first with ligroine then with caustic potassa-solution, and afterwards submitting the oily fluid to fractional distillation, the authors obtained diphenylketon as a beautifully-crystalline body, fusing at about 49° and boiling at 300°, yielding on elementary analysis results which led to the formula $C_{13}H_{10}O$ diphenylketon. In the presence of anhydrous phosphoric acid, benzol behaves with benzoic acid as an alcoholic does with acids, the benzol hydrogen being eliminated as an alcoholic hydrogen;

$$C_6H_5.H+C_6H_5.CO.OH=C_6H_5.CO.C_6H_5+H_2O;$$

the authors take, for this method of preparation of diphenylketon, 5 parts of benzoic acid, 6 of benzol, and 8 of anhydrous phosphoric acid, and heat for about five hours.

Researches on the Glycerine Derivatives.—L. Henry.—This exhaustive memoir, treating on the glycid and propargyl compounds, is elucidated by lengthy and complex formulæ.

Perchlorphenol.—V. Merz and W. Weith.—After first referring to the researches of Erdmann, Laurent, Schützenberger, and others on this subject, the authors describe the method of preparation of per- or penta-chlorphenol by treating with chlorine gas a mixture of 3 parts of phenol and 1 of chloride of antimony placed in a suitably-constructed vessel in a water-bath. After a somewhat tedious process of purification, there is obtained perchlorphenol, a solid crystalline substance soluble in ether and alcohol. These solutions exhibit acid reaction to test-paper. Perchorphenol fuses at from 186° to 187°, and may be sublimed; potassium-perchlorphenylate, C_6Cl_4OK, obtained by treating perchlorphenol with potassa, is soluble in a mixture of ether and alcohol, crystalline, contains 12·87 per cent of potassium. The authors further describe at length the action of nascent hydrogen, of concentrated nitric acid (which, at the ordinary temperature, converts perchlorphenol into perchlorchinon), of chloride of phosphorus upon perchlorphenol. When the above-mentioned potassium salt is submitted to a high temperature, there is formed perchlorphenyl oxide, C_6Cl_4O, molecular formula—



Its mode of formation from potassium-perchlorphenylate is elucidated by the following formula—$C_6Cl_4.OK=KCl+C_6Cl_4O$.

Physical Feasibility (Physikalische Mœglichkeit) of the most Recent Hypothesis Set Forth by Kekulé Concerning Benzol.—A. Michaelis.—This algebraico-physical essay is, notwithstanding its scientific value, not well suited for abstraction.

Monochlorcrotonic Acid Obtained from Croton-chloral.—C. Sarnow.—This monograph is divided into the following sections:—introduction, treating on the acid ($C_4H_4O_2$) obtained by Geuther from monochlor-tetracylic acid; monoclor-crotonic acid and its salts; monochlor-crotonitrile (C_4H_4ClN); monochlorbrom-butyric acid ($C_4H_5ClBrO_2$) and its salts.

On Some Pigments Derived from the Aromatic Azodiamines.—Dr. A. W. Hofmann and A. Geyger.—The first instalment of a lengthy monograph on this subject, this part treating on azodiphenyl blue.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, April 18, 1872.

Description of a Newly-invented Press for Extracting the Juice from Beet-root Pulp.—M. Camponnois.—This contrivance, illustrated by a woodcut, appears to be in every respect superior to the machinery now in use for this purpose.

Atmismometer.—M. Piche.—The description of an instrument invented by the author, and destined to measure the degree of evaporation and its rapidity; it is therefore a complement to the psychometer.

Glass-made Plummer-Blocks and Axle-Bearings.—MM. De Camus and Haret.—From what is stated here, it would appear that glass is successfully substituted by the authors for bronze, in the pieces of machinery just mentioned. The use of glass for the purpose alluded to seems to be attended with many advantages, and among these that of requiring less labour in making the articles, and greatly decreased consumption of lubricating material.

Les Mondes, June 13, 1872.

Inspector-General of Meteorological Stations in France.—Dr. Charles Sainte-Claire Deville has been appointed to the post just named.

Petites Annales de Chimie.—Dr. Maumené.—Under this title the author continues to expound his views on theoretical chemistry. This memoir is illustrated by a series of formulæ.

Laws relating to the Solubility of Salts and the Elementary Gases in Water.—D. Tommasi.—The author states that for salts having the same chemical formula (sulphates, bromides), the co-efficients of solubility in water are in direct relation to their specific heat. This is illustrated by a series of examples exhibited in tabulated forms. As regards the elementary gases (chlorine, oxygen, &c.), their solubility in water is in the inverse ratio of their specific heat.

June 20, 1872.

Catalogue of Raw Materials.—M. Bernardin.—The author has published, first, a descriptive catalogue of all the oils, next, of all the textile fibres, and recently, of all tanning materials, and is now occupied with a similar work on woods. According to the brief account here given of these works, they are highly valuable to industry and commerce.

Cause of the Spectrum Rays.—A. Cauchy.—This paper contains an account of the cause of the spectrum rays, as explained by the undulation theory of light.

Modification of the Electric Machine.—L. Brunelli.—This paper treats on the improvements made by A. Kundt in the instrument alluded to.

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A Lightning-Conductor Destroyed by Lightning.—M. Désiré.—An account of an occurrence in Belgium; a lightning-rod was completely demolished, and great damage done to the building it was intended to protect.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 234, June, 1872.

This number contains no original papers relating to chemistry.

NOTES AND QUERIES.

Iodine.—(Reply to J. S.).—You will have to make a full analysis of the material. Consult Fresenius, or, for volumetrical methods, the latest edition of Mr. Sutton's excellent work lately advertised in the CHEMICAL NEWS.—A.

Salts of Chromium.—(Reply to "Chromium").—As laboratory specimens, yes; commercially it would be difficult, not however impossible, but would add to the cost of the material; practically the commercial products are pure enough for use.—X.

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THE

CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE.

(WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE.")

A Journal of Practical Chemistry

IN ALL ITS APPLICATIONS TO

PHARMACY, ARTS, AND MANUFACTURES.

EDITED BY

WILLIAM CROOKES, F.R.S., &c.

VOLUME XXVI.—1872.

LONDON:
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THE CHEMICAL NEWS.

VOLUME XXVI.

EDITED BY WILLIAM CROOKES, F.R.S., &c.

No. 658.—FRIDAY, JULY 5, 1872.

THE PROPOSED ASSOCIATION OF MANUFACTURING CHEMISTS.

It has been suggested by a correspondent in our issue of last week that considerable advantages would result to manufacturing chemists and their managers by the formation of an association devoted to the interests, commercial and technical, of chemical industry. It is our purpose to submit to our readers a more prominent notice of this suggestion, according as it does with views long held by us.

There are but few industries that have no representative body, and amongst these few ranks manufacturing chemistry. That manufacturing chemists should not be represented by any general association is not so strange as, on first consideration, it may appear; for the utilisation of by-products, by which manufacturing chemistry has attained much of its important commercial standing is a recent event in the chronology of chemical industry. But now, as our correspondent writes, "the time has come for an Association of Manufacturing Chemists, holding an annual gathering, at which the manufacture of at least the great staple, sulphuric acid, might be discussed, scientific and technical papers of general interest read, and problems of various kinds considered." The benefits that would accrue to the manufacturers themselves from membership of such an association it is difficult, from the variety, to enumerate. In the first place, the expense of many useless experiments would be saved by reference (in after-time) to the collected papers of the association, and especially by personal reference during a meeting of the chief or sub-associations. For we anticipate that the necessary result of an annual meeting would be the formation of auxilliary local associations in the several centres of chemical industry. Not only would the manufacture of sulphuric acid, chlorinated products, ammonia, economic heating, construction of plant, &c., receive their due amount of attention—more than now, because inventors or introducers would be brought into closer contact with manufacturers on the large and small scales, receiving notes of failure or hints of improvement where their processes were employed—but data upon which might be founded remunerative utilisations of by-products would probably be evolved. At present, save in rare instances, there is little communication on points of detail between manufacturers, yet no one better than the manufacturer knows the essential and expensive character of such detail, upon which the successful issue of his process not unfrequently depends. As we have said, an Association of Manufacturing Chemists would form a medium for the interchange of this detail. While, as our correspondent observes, there may be numerous methods of a kind which manufacturers never dream of patenting, and which they would be glad to exchange and reciprocate with others.

It may be advanced that the preclusive character of certain "trade secrets" would form an insuperable obstacle to the smooth working of the association. We do not think so. The day for the preclusion of knowledge in any department of science has almost passed away, for, except in isolated cases, in any process where the demand for the result is pressing, it is more than difficult for the manufacturer to prevent some clue falling into the hands of others. Moreover, our patent regulations are at least sufficiently stringent to remove serious objection from this side of the question. Of course, no manufacturer would give countenance to the exposure of the results of experiment while these results were still experimental and unpatented, whether the account were from his own laboratory or illicitly from that of others. Another point is that manufacturers would for their surplus stock of information on points useful to others gain an interchange from the surplus stock of others information useful to themselves.

The Association, it is needless to remark, would in no way trespass upon the ground occupied by the Chemical Society, for it would discuss questions of prime cost and market price that a purely scientific society cannot consider. But we need not argue upon contingent results alone, for, besides the Iron and Steel Institute mentioned by our correspondent, we could indicate several instances of the benefit accruing to manufacturers from their combination; indeed, it may be asked, is not the advanced state of technology an effect of combination, either actually or virtually, by means of quickened channels of communication. Many other inducements to the formation of such an association, some of which have been hinted by our correspondent, we cannot consider here, nor is mention necessary, for they will form individual incentives to the consummation of the proposal.

Finally, we throw open the columns of the CHEMICAL NEWS to the discussion of preliminary arrangements, and earnestly invite the correspondence of Manufacturers and their Managers upon the subject, feeling that in so doing we are co-operating with them in advancing the interests of chemical industry.

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CHEMISTRY AND THERAPEUTICS.

In an address on this subject delivered last year by Dr. Hofmann to the Medico-Chirurgical Society of Berlin, the lecturer gave an account, at the outset, of the progress of chemistry in study of the hydrocarbons, and showed how chemical analysis had led to a knowledge of the active principles of medicines that had long been in use. Referring to the advantages accruing to therapeutical science from a study of chemical transformations, he spoke to the following effect:—

"There are a number of substances which can be extracted from organic matter only in very small quantities, and in a somewhat impure state. The study of chemical transformations enables us to obtain large quantities of these perfectly pure, and with little expense. Discoveries of this kind form a very interesting episode in organic chemistry."

During the last thirty or forty years the attention of chemists has been largely directed to alcohol; and the researches of Dumas and Liebig on the subject are well known. Dumas discovered in wood-spirit a new alcohol, having properties analogous to those of spirit of wine or *ethylic alcohol*, and he gave it the name of *methylic alcohol*. The chemists then began to see that they had in these two, ethylic and methylic alcohol, the prototype of a large class of substances, the most important among organic combinations. Then commenced an eager search after new alcohols, which has hardly abated up to the present. The various parts of organic chemistry have been explored with this object, and the search was not long without result. In an oily liquid obtained in the manufacture of alcohol, as an accessory of the fermentation of sugar, and which, on account of its bad smell, is carefully separated from the spirit of wine, Cahours found a third alcohol, and the rejected product came to acquire high scientific importance. This was *amylic alcohol;* also found in oil of potatoes. It has all the properties of other alcohols,—and when subjected to oxidating agents, produces an acid, in the same way as methylic alcohol is changed into formic acid, and ethylic alcohol into acetic acid. What was the surprise of chemists, on finding that this acid was the same as that obtained in very small quantities from the root of valerian! And as soon as science showed that this expensive substance could be prepared from oil of potatoes, it became the object of an important industry. Its salts, especially the valerates of zinc and bismuth, are now largely used for medicinal purposes.

Among the organic acids earliest known to chemists was *lactic acid*. Scheele first observed it in acid milk; it was afterwards found in gastric juice, sourkrout, and the juice of cucumbers. But it was not till the relation between sugar and lactic acid became known, and the acid was proved to form only at the expense of saccharine matter; it was not, in short, till the conditions of its manufacture were known, that it was introduced into therapeutics, and now, in the form of lactate of iron, plays such an important part.

A similar case is that of *succinic acid*, though it is not so much used in medicine as lactic acid. It was formerly obtained by dry distillation of yellow amber, but in very small quantities, and with many impurities. No such costly method is now followed. Analysis proved that the molecule of succinic acid differed from that of malic acid only by the atom of oxygen. Now it was shown by Dessaigne, that there is in the berries of the *Sorbus aucuparia* (or quickbeam), an abundant store of malic acid, which can be transformed into succinic acid by a simple process of fermentation. All the succinic acid of commerce is produced thus.

The manufacture of *benzoic acid* has undergone a transformation not less remarkable. The nature of this acid only began to be known in the end of last century. *It was formerly* extracted almost exclusively from benzoin; but very little of it is now obtained in this way. In 1829, Liebig discovered in the urine of herbivorous animals the acid called *hippuric acid*, and which is transformed by fermentation into benzoic acid. Later, Dessaigne proved that the same transformation was obtained by boiling with concentrated hydrochloric acid, in which process a very interesting secondary product is obtained, viz., *glycocol*.

Another acid deserves notice, though less important in therapeutical science, viz., *formic acid*. Chemists have found in distillation of oxalic acid, a source which furnishes this acid much more readily and in a pure state than the bodies of the insects from which it takes its name.

The remarkable properties of *glycerine* are ever finding new applications in pharmacy. It was discovered by Scheele in 1783, but it is only since the classical labours of Chevreul on fatty substances have enabled us to understand, in all its simplicity, the process of saponification, that the industrial preparation of fatty acids and of glycerine has been undertaken with success. Since the adoption of aqueous saponification, the employment of glycerine has been largely extended.

And it is not only from the direct employment of glycerine that therapeutical science has reaped advantage; it has also been benefitted through the study of its transformations, which chemists have recently investigated with great success.

It has been long known that the irritating properties of the flour of mustard are due to an æthereous oil, which may be obtained by distilling mustard with water. M. Will determined the nature of this oil. He found it to contain, in combination with sulphur and cyanogen, an organic radical called *allyl*, and which had already been met with in other substances,—in oil of garlic *e.g.*, where it combined with sulphur to form sulphide of allyl. In studying the action of iodide of phosphorus on glycerine, Berthelot observed the formation of a substance in which this radical unites with the iodine to form iodide of allyl; and thereupon occurred the idea of accomplishing the synthesis of oil of mustard or allylic sulphocyanate, by causing a metallic sulphocyanate to react on iodide of allyl; and, in fact, by distilling this iodide of allyl with sulphocyanate of potassium, oil of mustard is obtained with all the characteristic properties of that which is furnished by the plant. Oil of mustard is now mostly prepared in this manner.

Another synthesis may here be briefly alluded to. The *Cochlearia officinalis* furnishes an oil known to pharmacists as spirit of cochlearia. This oil has recently been shown to have a constitution analogous to that of oil of mustard. It is *sulphocyanate of butyl;* a combination which is easily produced artificially.

The instances that have been cited may suffice to show that the study of transformations in organic substances has been the origin of more simple and less costly methods for the preparation of substances the curative effects of which experience has demonstrated.

A. B. M.

WHAT IS THE ATOMIC WEIGHT OF INDIUM?

By S. E. PHILLIPS.

The popularisation of science is one of the cheering aspects of the present age, and the Royal Institution is at once one of the highest and most efficient of guides in the new department. The science of chemistry has two parts, which often wisely involve distinct professorships: one of laboratory manipulation,—the technical art; the other of chemical philosophy, whose aim is the collocation and orderly arrangement of the accumulating infinitude of facts. With an ardent and loving aptitude for manipulation and details, the amateur is not absolutely excluded from the former; but his more legitimate

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position is undoubtedly with the latter. The *rôle* thus assigned is, however, one of extreme difficulty, apart from the conflicting necessities of daily life and business; and he is often compelled to proceed with a trembling uncertainty from the paucity of means of research.

It was under this impression that I offered some brief remarks on the character and limitations of the factors which conjointly determine the atomic weights of chemical science (CHEMICAL NEWS, vol. xxv., p. 63), and the same feeling now prompts the present inquiry.

All Professor Odling's efforts have a characteristic neatness, elegance, and force, commensurate with his high position and attainments; it is therefore the more unwelcome when an outside amateur cannot indulge in unmixed admiration. Although "the quantity of indium which unites with 8 parts by weight of O and with 35·5 of Cl, was found by Winkler to be 37·9 and by Bunsen 37·8,"* yet up to very recently the atomic weight has been regarded from the diatomic point of view, and recorded as 75·6. Of the reasons for this I am wholly ignorant, and it now appears that the vapour density has not yet been determined!

The notations given were thus—

In 76·53	$2KCl+InCl_2$
Nitrate	$In+2NO_3$
Sulphate	$In+SO_4$

A cursory glance of these types naturally suggests the following, in old notation:—

	KCl+InCl
Nitrate	$InO+NO_5$
Sulphate	$InO+SO_3$

Meanwhile M. Bunsen has determined the spec.fic heat constant to be 4·3 instead of the hypothetic normal of 6·5, and, multiplying the atomic weight by 1½, he gives the following:—

In 113·4—		In 37·8.
The chloride	$InCl_3$	InCl
The yellow oxide ..	In_2O_3	InO
The normal hydrate	InH_3O_3	InO+HO
The nitrate	$In(NO_3)_3$	$InO+NO_5$
The sulphate ..	$In_2(SO_4)_3$	$InO+SO_3$
The black oxide ..	InO_2	$InO+In_2O_3$ or In_3O_4

which I have compared with my *á priori* projection. The manuals published in 1869-70 state that indium is 75·6, and combines with 2Cl, &c. Those in 1870-71 affirm its atomic weight to be 113·4, and that it is tri-atomic, &c. And the burden of my inquiry is, whether this easy method of altering the alphabet of the science, without a careful regard to all the factors which affect the result, is wise.

Among these factors, and in addition to the non-volumetric determination, I complain not that the Professor has omitted all reference to the specific refractive index, but I do take exception to the invalid apology for excluding the all-important reference to the chemism of the subject, as also a total disregard to the simple and crucial electrolytic determination.

On the contrary, I maintain that the general types of combination are determined by the position in the electro-series, and that a glance at the above notations naturally suggests the hypothesis of a mono-chloride rather than a bi- or tri-combination. While thus apparently ranking with the lowest and simplest type of salts, yet the black oxide would indicate a high position in those relations, perhaps considerably above either hydrogen or copper. At the same time it must be confessed that from such a slender series only very provisional indications can be fairly deduced, and the danger of reasoning in a vicious circle herein should be sedulously suspected.

It may be well, before attaching value to such indications, to compare the stranger with some well-recognised bi- and tri-atomics. Gold, *in relation* to O or Cl, is most definitively tri-; but that it is so *per se*, or that it therefore is equivalent to or replaces 3H, is a matter of which I find no evidence whatever. Any present list of gold combinations, or any imaginary slender list, before its relations were so well understood, would exhibit auric acid AuO_3 or $AuCl_3$, as more like sulphuric acid than any imaginary oxide or chloride of indium. Or, if we similarly compare the well-known binoxides or bichlorides of mercury or platinum, and try to divest ourselves of the accumulated facts in illustration of their electro-positive or combining functions; how very early it was seen that these chlorides tended to the formation of negative or acidulous characters in the chloro-platinates, &c.

If indium becomes a normal tri-oxide or tri-chloride, then its electro-position must be higher than mercury or platinum, or even carbon; and where are the facts leading at all in this direction? Its slender provisional portrait gives no such indications, and its weakly basic character is proclaimed in every feature. But then M. Bunsen says its specific heat constant is 4·3 instead of 6·5, and that its atomic weight must be multiplied by 1½. Be it so, if other factors point in the same direction, but the corresponding constant of chlorine is exactly 4·3, and that of nitrogen and hydrogen rather less, and there is no attempt to make these conform!

Referring to the volumetric factor, N is one vol., and its close chemical analogue P = ½ vol. Now this anomaly vanishes in their compounds, and ammonia or phosphonia both equally evince the normal 2 vols. Had this mysterious multiple discrepancy, of which we have many other instances, been ruthlessly rectified, as some have wished, by a doubled atom, then, besides disturbing the whole range of chemical congruities, all subsequent combination volumes would have been similarly deranged.

I anticipate that a similar state of things will be found to subsist with the similar multiple variations of the specific heat factor; and that the mysterious initial discrepancy will often vanish in the compounds, or conversely be disturbed in cases where inconsiderate changes have been made in violation of other and higher elements in the equation.

I am very sorry to be tempted to speak in advance, and to reason so much on such a restricted basis of fact, because a fuller knowledge may show that the normal chloride of indium is either a bi- or a tri-combination; but my inferences from the present limited facts are—

1. That the weight of indium exchanged in the voltaic circuit will be 37·8.
2. That the weight which corresponds to or replaces one H or other analogous element, in substitutional types, will be 37·8.
3. That the volumetric determination may be in agreement with that of H, either initially or in some of its compounds, and represented by 37·8.
4. That the electro-position and consequent reactions will bespeak a status adjacent to, but lower than, aluminium.

One word, in conclusion, on the studied suppression of the chemism of the subject, a factor of by far the greatest value in the whole series. How characteristic this is of modern methods we have pointed out in respect of the Hofmann treatise.

"He uses the word Chemism to express the dynamical or atomic forces involved—as we think—in all chemical phenomena; but the reference is only made once, near the end of the book, and then only in a parenthetical way, as if to show its irrelevance, while pourtraying the atomic or diatomic mechanism of varied atomicities, varied quantivalences, of atom-fixing powers or points, &c."

In regard to the higher value of the volumetric consideration, it should be observed that the protochloride of mercury is 2 vols., as well as the bichloride; and, still further, that the really corresponding chlorides of platinum are both 1 vol.!

* Professor Odling's Lecture at the Royal Institution, "On Indium," (CHEMICAL NEWS, vol. xxv., p. 266.)

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It may suit a numerical progression to treat it otherwise, and double the atoms to get the required volume, but what are the chemical facts? The chlorhydrargates and chloroplatinates, with the corresponding oxy-salts, are all strictly analogous both in type and function, although constituted of such diverse volumetric metals; and, what is far more to the point, these atoms or equivalents similarly exchange in the voltaic circuit, and their chemical substitutions in varied ammonias or other hydrocarbon radicals similarly correspond; and the implied ½ vol. Pt quite agrees, both chemically and volumetrically, with the 2 vol. mercury.

Chloride of Ammonium.	Chloride of Atmonium (type).
H_3H NCl.	H_6H N_2Cl.
H_3Pt NCl.	H_6Pt N_2Cl.
H_3HgNCl.	H_6HgN_2Cl.

Similar considerations apply to the aluminium chloride, which Dr. Odling gives as a trichloride, but which modern entanglements mostly regard as a hexachloride.

The Mendelejeff-Odling tabular series, however, bristle with such incongruities, and demand a separate notice.

ON ÆSCULIN.

By ROBERT F. FAIRTHORNE.

This principle is easily separated by the following process:—A quarter of a pound of horse-chesnut bark in moderately fine powder is moistened with half a pint of a mixture composed of three ounces of solution of ammonia (U. S. P.), and five ounces of water. This is packed in a glass percolator, in the neck of which a plug of cotton has been placed. A pint and a half of a weak solution of ammonia is poured on the bark, and allowed to pass slowly through.

The first half-pint of the liquid that displaces is set aside in a capsule and evaporated spontaneously until reduced to a syrupy consistence. The remaining pint is brought to the same condition as the first portion, by means of a sand-bath and gentle heat. These products are then mixed with one and a quarter ounces of pure alumina by rubbing together in a mortar. Allow the mixture to dry, which requires a few hours. Powder the dried mass, and boil it for five minutes in a flask with six ounces of alcohol (95 per cent). Filter this whilst hot, and pour six ounces more of boiling alcohol on the residue in the filter. Place the filtered liquid in an evaporating dish, and allow it to evaporate spontaneously until reduced to a semi-solid state, when impure æsculin will be found in a crystalline condition contaminated with some dark-coloured extractive matter.

In order to separate the æsculin from the colouring matter without loss, mix two ounces of cold water with it in the capsule, and having scraped it thoroughly from the bottom of the vessel, pour it into a vial. Add one fluid ounce of ether to this, and agitate for a few minutes. Allow it to remain undisturbed for twenty-four hours. Afterwards pour the mixture on a filter, and when the dark-coloured fluid and the ether have passed through, wash with about two drams more of cold water.

The æsculin is now nearly pure. In order to make it perfectly so, all that is necessary is to allow it to dry in a warm place, powder it, pass half an ounce of pure benzole through it after having been placed on a filter; then treat it in the same manner with an ounce of ether so as to remove any paviin that may be present, that substance being readily dissolved by ether.

Sixteen grains appears to be the average weight of the purified active principle obtained from 4 avoirdupois ounces of the horse-chesnut bark by this process. After trying various methods for extracting æsculin, I found none so satisfactory as this one, either in regard to simplicity, the quantity yielded, or the quality of the production.

Æsculin, as thus prepared, appears to the unaided sight, as an amorphous powder, almost white, being of a slightly pale buff shade. Under the microscope (magnified 220 diameters) it is proved to consist of minute needle-shaped crystals.

From its alcoholic solution its crystals arrange themselves in stellular tufts, the aciculæ, pointed at the ends, radiating from a common centre in every direction, forming a very beautiful object, the transparent prisms glistening with more than ordinary lustre.

I find that it is soluble in the following liquids:—Alcohol, acetic ether, strong acetic acid, solution of carbolic acid, solution of the hydrate of chloral, and in the alkaline solutions.

When æsculin is added to nitric acid it becomes yellow, and if ammonia in excess is added to this mixture a bright cherry-coloured liquid is produced. When sulphuric acid is substituted for the nitric acid, and ammonia added, the same colour appears.

NEW MEANS OF SEPARATING AND UTILISING THE PHOSPHORIC ACID FROM IRON ORES.

By JULIUS JACOBI,
Director of the Smelting Works at Kladno, Bohemia.

The method of working proposed by the inventor, consists in changing the insoluble basic phosphates contained in the ores into soluble acid phosphates, and the separation of the soluble phosphates, by a simple process of leaching.

In order to attain this result, the ore is treated with a compound of sulphur and oxygen usually most advantageously and cheaply with sulphurous acid in the gaseous state or in solution, for which purpose a very dense ore must naturally be pulverised, a pyritous ore or one containing carbonic acid must be well roasted by well-known methods, while a porous ore which allows the penetration of the liquid into the pores, can be used in pieces of moderate size. The ore thus prepared is placed in receivers the size and shape of which must be dependent on various conditions, and water impregnated with sulphurous acid is turned upon it, or the sulphurous acid gas is conducted at once to the ore, while a stream of cold water is turned upon it at the same time, so that the absorption of the sulphurous acid into the ore takes place through the medium of the water.

The latter would be especially good with porous ores, since the gas readily enters the pores, and its operation would therefore be more rapid.

Moreover, as a simpler and more rational mode of working, the sulphurous acid might be forced under pressure into the solution.

The solution after this operation should stand over the ore until no further reaction takes place, and until the greater part of the phosphoric compounds has passed into solution. It is very important to observe this carefully, and not to allow the reaction to continue too long, since otherwise phosphates may be again precipitated. The solution is then drawn off, and replaced by water, which will remove the salts rendered soluble but not previously removed. This washing is continued as long as phosphoric acid may be detected in the wash water. If phosphoric acid still remains in the ores, the same process may be gone through with once or several times more, according to the degree of purity required for the ore. It is evident that the duration of the operation must be regulated by the amount of phosphate in the ore, and its porosity. After the last treatment with acid, the ore must be well washed with water, to remove all traces of the acid.

The water remaining after each treatment, which contains the phosphorus compounds, is collected and heated

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directly by a naked fire, or by passing steam pipes through it, in order to drive off the sulphurous acid, by which means a portion of the phosphates will be precipitated. The sulphurous acid thus driven off may be allowed to escape into the air, or if one is economically inclined it may be again united with water and used over again. The liquid, in which by heating a portion of the phosphorus compounds have already been precipitated, is then treated with burnt lime, and allowed to stand until the whole precipitate, which contains all the precipitable substances, has settled to the bottom of the tank. The addition of lime is of course only necessary when, by heating the liquid to drive off the sulphurous acid, all the phosphorus compounds are not precipitated, which is the case with many ores. Thereupon the clear liquid is to be drawn off, and the deposit, when it has attained the right consistency, removed. This is now, on account its containing phosphoric acid, a very valuable product for agriculture and the arts, and may be sold for direct application in agriculture, or for further working up. In many cases the proceeds from this sale will cover a large part of the expense of treatment. The preparation of the sulphurous acid is effected by some known method from sulphur, pyrites (where these are to be obtained cheaply) or from other similar substances.

The purified ore should be taken from the receivers and treated in shaft furnaces, when a good pig-iron will be obtained. If the ore has been previously pulverised it is well, before charging it into the furnace, to make it into bricks by the use of lime or some other cementing material.

By the removal of the phosphorus compounds the iron ore becomes somewhat richer in iron, as well as purer.—*Bayerisches Industrie und Gewerbeblatt.*

ON THE RESULTS OF DISINFECTION ON THE BATTLE-FIELDS IN FRANCE.

Report of C. JUNGHAUS.

In the month of October, commissioned by the Directory of the German Chemical Society at Berlin, I visited the environs of Metz, and was during most of the time actively engaged in the work of disinfection upon the battle-fields of Saint Privat, Amanvilles, and Bernéville. The means at command for the accomplishment of this work were chloride of lime, manganese lye (the acid residuum from the manufacture of chlorine gas), and carbolic acid in large quantities. Besides these, green vitriol and a disinfecting powder, which contained carbolic and green vitriol, were also on hand in smaller quantity.

The trench graves (*massengrabern*) on these fields were very numerous and near together, often concealing from one to two hundred bodies apiece. For these, and for the great number of horse carcasses lying buried almost everywhere, it was necessary to obtain, with the means at our disposal, a disinfection which should be not only immediate, but effectual for a long time. For this purpose, a prompt and copious flow of chlorine gas was procured from chloride of lime and manganese lye, and applied in the following manner to the large burial mounds. Upon each of these mounds, on which the earth lay to a depth of from 1 to 3 feet, a long trough was dug with a spade; into this the rich manganese lye was allowed to run. Chloride of lime in large quantities, sometimes reaching 100 lbs., was then thrown in, the channel covered with earth, and the mound strewn widely with chloride of lime. Earth was then thrown over all, and the hill heightened where necessary. After ten or twelve days, as long a time as it was possible to extend the observations, a distinct chlorine smell was perceptible at a distance of about one hundred paces from the place where several of the burial mounds so treated lay close together. This smell was more particularly noticeable after a hard rain, which brought the chemicals together in solution.

It was fully proven that manganese lye by itself is a powerful disinfectant. Several horse carcasses which, like all the rest, were much further gone in decomposition than the human bodies that we encountered, and which emitted a very great stench, were abundantly sprinkled with manganese lye alone, for on that day we were not able to add any chloride of lime. After several days, when we returned to work again upon this place, all stench had disappeared. It should be mentioned that the lye was used undiluted, just as obtained from the Union Chemical Works, at Mannheim.

The carbolic acid, which was a better quality of the crude acid of commerce, said to contain 60 per cent of pure acid, was also applied to the horse carcasses. This application was continued as long as the supply would permit, in connection with green vitriol and the disinfecting powder, Those carcases which lay mostly uncovered, or on which earth had been thrown as they lay, were, as far as possible, sprinkled directly with carbolic acid. Either green vitriol or the disinfecting powder was then put on, and the earth thrown up over the whole. Certainly no immediate *disinfection* could be obtained with the carbolic acid, highly prized though it be for retarding *putrefaction*. This was all the more true when the green vitriol and disinfecting powder were applied along with it. The stench in these cases was finally dispelled by a single application of chloride of lime, so that no renewal could be perceived. These points were especially observed in the case of a large number of carcasses lying in a stable belonging to the farm-house of Champênois, at Bernéville, which had been destroyed by fire. It was not possible to cover them with earth. It was in its application as an antiseptic to these great masses of flesh, which in all probability even now are no better interred, that carbolic acid was most constantly useful.

From these observations and experiences obtained on the spot, I think I may draw the conclusion that it is advantageous, in cases of this kind, to saturate thoroughly, as early as possible, the earth overlying the graves with salt solutions that have the power of absorbing or destroying gases. Green vitriol and manganese lye possess, in addition to their well-known efficacy, the advantage of cheap production. If foul gases have already escaped, the immediate application of chloride of lime is the most convenient means for their destruction.

Bromine, just as energetically efficacious as chlorine, has already been advantageously applied to the disinfection of foul-smelling waters. It is too volatile to use on the graves of battle-fields, besides being difficult of application.

Horse carcasses, which unfortunately are always badly interred, should be at once impregnated with carbolic acid. For this purpose it is sufficient to sprinkle the acid upon the ears and abdominal cavity, and upon the immediate surroundings of these parts.

A careful burial, however, without too much crowding, is undoubtedly the most certain way of preventing subsequent evil consequences, even if it require the expenditure of a great amount of time and labour. A very great deal has been done in time of war by the authorities and by private individuals from motives both humane and selfish. A proper burial of the victims of the war is, however, yet to be secured.—*Dingler's Polytechnisches Journal.*

Oldham School of Science.—A laboratory for the use of students in practical inorganic chemistry having been opened at the Oldham School of Science and Art, twenty-one *artizan* students presented themselves for examination by the Department on the 3rd of May, and nineteen of them have passed.

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NOTES FROM THE INTERNATIONAL EXHIBITION OF 1872.

In the absence of an Official Report upon the Recent Scientific Inventions and New Discoveries exhibited at South Kensington this year, we present to our readers a short account of the principal features of this department of the Exhibition. Entering from Exhibition Road, we are at once within the precincts of that curious collection, the Indian Court. This court has a relative interest for the scientific visitor, because as here represented the majority are the results of hand-labour, while the remainder of the building is devoted to the products chiefly of machinery, or to the machinery itself and its construction. The Indian contributor presents to us those elaborately carved caskets, the delicate filagree work in gold and silver, for which he has been justly celebrated through so many ages. There is, too, a case of native musical instruments, and these, though perfectly beyond our comprehension in other respects, show that there has been much careful thought expended upon the construction of their gourd-shaped resonant chambers. At the end of the Indian Court is the entrance to the Stationery Department, and here are exhibited the process of Heliotype Printing by the Heliotype Company and the Woodbury Process by the Permanent Printing Company. Mr. S. H. Cowell has here a process, termed Anastatic Printing, which appears suited to many useful applications. The design drawn upon ordinary paper with the prepared ink is transferred from the paper to a metal plate, from which an indefinite number of copies can be produced, the invention being intended to supersede lithography. Appropriately Messrs. Parkins and Gotto exhibit on the opposite side of the room a Lithographic Printing Machine by Mr. S. Barrett, as well as machines for cutting and stamping paper. In the next room are exhibits illustrative of the process of paper-making, but to the chemist there is nothing of interest, excepting the Pulse Pump for laboratory use of M. Mendelejeff, to which is, however, appended very little information, a remark equally applicable to an interesting Thermo-Electric apparatus in this room. Passing a long array of cases containing some elaborate specimens of Valentines, writing-cabinets, stationery with every variety of device, &c., a case containing specimens of half- and whole-stuffs for paper-making, we enter a gallery lined with newspapers and periodicals in all languages, from Greek to Gaelic, from Hungarian to the equally unpronounceable Welsh. This corridor conducts to the room devoted to scientific inventions, and we are immediately before the table at which the attendant explains the uses of the Fire-proof Starch, and shows how readily unprepared muslin may be ignited, while muslin starched with the Fire-proof Starch only smoulders. The starch can be supplied at 8d. per lb., certainly cheap enough for use where there is more than ordinary risk, as in ball-dresses or bed-room hangings. The colour, Messrs. D. Nicoll and Co. state, is the same as with other good kinds of starch, and the fire-proof starch contains no ingredient of any kind unpleasant or prejudicial to health and comfort. Farther in the room we have Colonel H. Stuart Wortley's Results of New Dry Photographic Process for working by the use of collodio-bromide of silver without a silver-bath. The plates are very clearly defined, and we wish they were more numerous. Near at hand is a Foul Air Purifier for sewers, exhibited by Mr. Ludstone, and consisting of a ventilating lantern containing charcoal or the disinfectant. With M. Leon Delperdange's Cylinder for conducting Telegraph Wires Underground there is exhibited a Telegraphic Apparatus, founded upon Morse's system, the invention of M. De Torville. This instrument is in use upon some Russian lines, and is very simple in construction, the whole of the apparatus being arranged upon a small table, in the interior of which is some mechanism for winding up and drawing forward the paper slip as it is printed. On the wall are diagrams in which Dr. Karl Ticinsky propounds the Quadrature of the Circle, a matter not very interesting to the visitor. Sir Joseph Whitworth and Co. exhibit models of a Breech-loading Naval Gun and a Breech-loading Field Gun and Carriage, as well as a Six-pounder Breech-loading Rifled Gun and Carriage made of Sir Joseph Whitworth's Patent Compressed Metal. Messrs. Siemens Brothers and Lœffler exhibit Dr. Siemens's Apparatus for Working Pneumatic Despatch Tubes, on the continuous current system, as established for the transmission of postal telegrams between the West Srtand and Central Telegraph Stations, together with an Exhauster or steam-jet arrangement for drawing the air through the tubes. Dr. Siemens also exhibits his Deep Sea Photometer, for comparing the intensities of light at different depths of water. The apparatus was very successfully used on board H.M.S. "Shearwater," in August, 1871, for comparing the intensities of light at different depths of the Straits of Gibraltar. Further in the centre of the room is a valuable collection of acoustic apparatus by Messrs. Lefèbre, of the Hague, but the utility of the invention cannot be made apparent without diagrams. Lieutenant-Colonel Clarke, C.B., R.E., has a model of Three-legged Shears admirably adapted for a wharf too narrow to admit of the back leg traversing horizontally in the usual manner. Mr. Bessemer exhibits a very complete series of sectional models illustrating the Bessemer principle of constructing Continuous Low-Pressure Ordnance; while Major Palliser's contribution of a Service Muzzle-loading Sixty-four-pounder Rifled Gun, converted on the Palliser principle from a smooth bore thirty-two-pounder gun, and having fired 2300 rounds, may be considered to complete the artillery exhibits, together with the specimens of Gunpowder, recently tried by the Committee on Explosives, and a Crusher Gauge for directly determining the pressure of fired gunpowder, both by Captain W. H. Noble, R.A. Distributed through the room are models of the Newport Patent Puddling Furnace, exhibited by Mr. Jeremiah Head; a Patent Hot-Blast Fire-Brick Stove, exhibited by Mr. T. Whitwell; a Kiln for burning bricks, lime, cement, &c., by Mr. A. Batchelar; and Mr. Danks's Patent Puddling Furnace. Messrs. Lynch and Co. exhibit a knobbed Poison Bottle to prevent use of poison by mistake in a dark or dimly-lighted room.

The actual results of chemical processes are very scantily represented, being confined chiefly to the preparation of the pulp for paper making. Mr. F. B. Houghton exhibits a series of four bottles illustrative of the manufacture of pulp from wood, in reference to recovering the alkali without evaporation or calcination. The liquor in which the wood has been boiled to disintegrate the fibre is treated for the coagulation of the resin, the remanent liquor being treated as if it were new soda-ash, and the resin as a valuable by-product. Permanganate of soda is preferred as a bleaching agent by the inventor. There are also drawings of Apparatus for Recovering Soda used in Preparing Fibre for Paper making, which obviously we cannot copy here; they are exhibited by Messrs. W. W. Ladelle and A. G. Southby. Messrs. B. Donkin and Co. exhibit an enormous Spherical Boiler for boiling and washing rags, hemp, straw, &c., for paper manufacture. There are two Non-conducting Cements for covering boilers and steam-pipes, exhibited by Messrs. Leroy and Co., and by Messrs. Fox, Head, and Co. Almost at the end of the room is the model of a house or shed constructed of waterproof paper, and exhibited by The Universal Paint and Waterproof Fibre Company, the paper being rendered waterproof by the Patent Cupro-Ammonium Process, of which the company are the licencees. Cupro-ammonium is, we believe, an arbitrary term, the material being prepared by the immersion of copper turnings in concentrated liquid ammonia, with access of air. After some time the ammonia is stated to acquire a deep blue colour, and peculiar agglutinising or solvent properties. Paper or almost any

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fibrous substance dipped into this liquid becomes so far reduced, that by being pressed upon itself, or upon another sheet similarly prepared, a solid mass of any required thickness can be obtained. Copper-oxide dissolved in ammonia is said not to have the same solvent action. Paper may thus be rendered waterproof, being afterwards corrugated for roofing purposes, &c., at an increase of 40 per cent upon the original cost. Mr. H. Deacon contributes drawings of his Method of Obtaining Chlorine. The process consists in passing a heated mixture of air and hydrochloric acid over sulphate of copper, or over pieces of pumice or brick saturated with a solution of this salt. The velocity with which the mixed gases pass over the surface of the active material causes considerable variation in the comparative amount of chlorine produced.

The electrical exhibits of this year are by no means numerous. Leaving the room devoted particularly to scientific inventions, and which we have almost exhausted, we meet with the Electric Motor Clock of Messrs. Cooke and Son, of York. This clock has now been driving the clocks in the several rooms of the Exhibition for two years; to those who know the difficulties of electric horology a sufficient recommendation. In the French Court is exhibited by Messrs. Moseley and Son a novel form of Electric Clock, in which the electric current is called into action only when the oscillations of the pendulum are decreasing; by this means the consumption of materials in the electro-motive element is reduced to a minimum, and the regularity in keeping time ensured for a longer period.

The first actual application of electricity to the uses of organ construction was made by Mr. Barker, of Paris; and Messrs. Bryceson Brothers and Co., seeing the great advantages which the system offered, introduced it into England in the organ built by them for Her Majesty's Opera in 1868. In churches, halls, &c., many positions can be utilised by this system that were formerly utterly impracticable. The organ exhibited in Room 13 is played by electricity, the organist literally telegraphing his manipulations through a cable. An electric current is completed round its corresponding magnet by pressing a key, and the armature being attracted causes the pallet to open and admit wind to the pipes. By an automatic arrangement the electrodes of the four cells of the single fluid battery employed are withdrawn from the exciting fluid when the wind is out of the organ, so that all waste of chemicals is suspended. We must, to be fair, acknowledge the superior workmanship of the ordinary manual organ of Messrs. Jones, whose instrument has met with unanimous commendation from the musical critics; and we cannot leave this portion of the exhibits without noticing the elaborately inlaid pianofortes of Messrs. Hopkinson and of Messrs. Erard. Messrs. Erard's instrument is exhibited in the French Court, and its interest is due to beauty alone; but the pianofortes of Messrs. Hopkinson embody an application of iron in the construction of what is termed "the back" of the instrument, decreasing the liability to get out of tune, especially in hot climates. This firm also exhibits some smaller instruments of extreme brilliancy and fullness of tone, to which the musical critics have accorded high commendation.

The exhibits offering the greatest attraction to visitors are undoubtedly the various newspaper presses. The "arte and mysterie" of printing has had its special interest for all ages of its use; and there are two machines in the present Exhibition, types of the wonderfully rapid progress that has been made since 1474. We allude to the Marinoni printing press, turning off its 12,000 copies of the *Echo* hourly; and to the "Walter Press," which derives its name from the enterprise and perseverance of its inventor, Mr. Walter, M.P. By this machine, the *Times*, *The Mail*—a tri-weekly reprint of the *Times*, and the *Scotsman* are now supplied to the public, with very little manual labour. The Walter Press is what is termed a "perfecting" machine, printing both sides of the sheet at one operation. The details of the machine are very simple. At one end of the framework of the press is a roll of paper several miles in length. This paper is led from the roll into a series of small cylinders, where it is damped. It is then brought between the first and second of four cylinders, supported above each other perpendicularly in a powerful framework. The highest of these cylinders is encircled by the stereotype casts from four pages of type, and the lowest cylinder is similarly surrounded by the casts of the type of the remaining four pages of the newspaper. Between the highest pair of rollers one side of the paper is printed; then passing backwards between the second and third cylinders, it is again drawn forward between the third and fourth cylinders, receiving an impression on the opposite side from the latter cylinder. The printed paper passes to the cutting cylinders, where it is cut into sheets. The manual labour required is therefore limited to the attendance upon the apparatus distributing the printed sheets, since the machine is self-feeding from the continuous roll of paper. The paper passes through the machine at the rate of nearly 1000 feet per minute, so that a roll of paper four miles long (as supplied by the paper mill), is printed and taken off in less than twenty-five minutes. The matrix of the type is taken from the whole page at one operation in *papier maché*, being rapidly dried upon heated surfaces. Into this mould stereotype metal is poured, the entire operation being completed in thirteen minutes. This marvellous celerity has been attained by careful investigation as to the best alloy for the stereotype metal, which, at the same time, must be readily fusible and sufficiently durable to stand the wear of many thousand impressions.

We should much like to notice the stoneware and other exhibits, but from a scientific point of view there is nothing further that calls for the extension of our description last year.

ON DYES AND DYE-STUFFS OTHER THAN ANILINE.*

By Dr. F. CRACE CALVERT, F.R.S.

Red Colouring Substances.—Madder.

THIS well-known tinctorial substance may still be considered as the most important of all the dye-stuffs employed by calico-printers, owing to the brilliancy of the colours, and their permanence under the action of light and soap, and the wear and tear which fabrics so dyed can sustain, as well as on account of the variety of shade and colour that can be obtained; one dyeing operation being sufficient to produce pinks, reds, purples, violets, puce, and black; and, notwithstanding the competition that madder colours have met with of late years from aniline dyes, I believe the quantity of madder consumed in England is quite as great at the present day as ever it was.

The employment of madder-root as a dye dates from the most ancient times, as is proved by the Egyptians using madder-dyed fabrics to wrap round their mummies. The Greeks and Romans were acquainted with it under the names of *Erythrodanon* and *Rubia*, and their modes of fixing it on cotton fabrics were the same as those now employed, namely, aluminous salts for producing reds, and salts of iron for purples and blacks.

The plant which produces madder is an herbaceous one, and is called *Rubia tinctorium*. It bears a yellow flower, and a dark red berry fruit. The red colouring matter exists almost entirely in the cortical part of the root, little or no colour being found either in the epidermis or in the ligneous or centre part of the root. M. Decaisne

* The Cantor Lectures, delivered before the Society of Arts. Revised and communicated by the Author.

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and M. Edouard Kœchlin have shown that the colouring matter in the fresh root is yellow, and becomes red under the oxidising influence of the atmosphere. The same process goes on, to a certain extent, in the roots of the plant when they are allowed to remain several years in the ground, especially in chalk formations. In France, the roots are allowed to remain in the ground two or three years; in Turkey and the East, from five to seven. In the latter countries and in Naples they are dried in the open air, but in Holland and France stoves are employed for this purpose. Naples and Turkey madders are imported in the root, and are known in commerce as Naples and Turkey roots, while those from France and Holland are ground, and sold under the name of French and Dutch madder.

One hundred parts of fresh root yield, on perfect desiccation, twenty parts of dried substance. The roots as imported always contain 16 or 18 per cent of water; the fresh roots, therefore, give 24 or 25 per cent of commercial madder. Dutch and Alsatian madder, after being ground, is stored in large casks, and kept for two or three years, when the colouring matter is developed, and its tinctorial power is much increased: if, however, it is kept five or six years, further changes ensue, and its value seriously decreases. French Avignon madder can be employed at once, although the quality is much improved by keeping it one or two years. The best Avignon madders are grown on lime formations. The roots that have a red colour are called *palus*, and those that are pink *rosées*, the former being considered the finest. The value of these madders is in ratio to the fineness of their powder, the finer powder containing the most colouring matter.

The nature of the chemical changes occurring in madder during the time it is stored, and which so much improves its commercial value, was entirely unknown until the elaborate and interesting researches of Dr. Ed. Schunck, F.R.S., published in the year 1851. He succeeded in isolating a peculiar ferment called *Erythrozym*, which possesses the property of decomposing a substance called by him *Rubian*. Rubian may be considered as a glucoside (this name being given by chemists to compounds of sugar with other organic principles), and is decomposed by erythrozym into a peculiar sugar and *alizarine*. Whether there are in the *Rubia*-root several glucosides which unfold themselves respectively into sugar and one of the colour-giving principles, or there is only one glucoside, and its colour-giving principle—as it is liberated—gets successively oxidised into alizarine, purpurine, &c., is not yet satisfactorily determined. Still this valuable discovery of Dr. Schunck has thrown much light on the subject, and has led to several important commercial improvements, to which I shall call your attention as I proceed. One hundred parts of dried madder-root consist of—

Soluble in cold water	55 parts.
Soluble in boiling water, and which contains the greater part of the colour-giving principles	3 ,,
Soluble in alcohol	1·5 ,,
Fibrous matter	40·85 ,,

I shall make no remark on the gum, mucilage, pectine, pectic acid, and pectates, which the *Rubia*-root contains, but state that the water extract contains also the yellow colouring-matter discovered by Kuhlman in 1824, and called by him *Xanthine*; but this colour has never received any commercial application, from its want of brilliancy. Water also dissolves another colouring principle, called *Chlorogenine*, which is decomposed by weak acids into sugar and a brownish-green matter. Both these colouring substances are sources of annoyance to the calico-printer, as they render very difficult the obtaining of pure whites in printed goods, and they dim the brilliancy of the shades produced by the combination of alizarine and purpurine with the mordants. Further, the cold water dissolves the sugar contained in the root, and on the Continent it is transformed into alcohol. The yield of alcohol varies with the nature of the root, and ranges between 7 and 10 lbs. per cwt. of root. This fact shows that there is from 10 to 15 per cent of sugar in the root.

Messrs. Julian and Roquet have based on the above facts a commercial process for preparing a purified madder, which they call *Fleurs de garance*, of which several million pounds are now manufactured in France per annum. It not only yields brighter colours than the original madder, but, as it does not soil the white parts of prints, its use saves the printer much soap and labour. To prepare the *fleurs de garance* the madder is mixed with 8 or 10 parts of water, and left for three or four days at a temperature of 75° to 80° F., when fermentation ensues, transforming the sugar of the root into alcohol, which is collected. The madder, deprived of all soluble substances, is dried, and ready for use. A hundred parts of madder yield from 55 to 60 per cent of *fleurs de garance*. I may state, *en passant*, that the injury which Dutch and Alsace madders sustain when kept too long in casks is doubtless owing to the fact that, after the erythrozymic fermentation is completed, an alcoholic and lactic one sets in, which acts injuriously on the colour-giving principles.

I now proceed to lay before you the outlines of two interesting processes for extracting commercially the two useful colour-giving principles, *alizarine* and *purpurine*.

The first is due to M. Leitenberger, and is based on the fact that purpurine is soluble in water at 130° F., whilst alizarine only dissolves at 170° F. He mixes madder with water, and heats the whole gradually, by means of a jet of steam, at 130°, at which temperature it is maintained for some time. The liquor is then run off and filtered. To the clear solution, lime—or, still better, baryta—is added, when a lake precipitates. This is washed and mixed with hydrochloric acid. The purpurine thus liberated is thrown on a filter, washed, and is ready for use. The madder remaining from the above operation is dried and heated in close vessels with wood spirit, which dissolves the alizarine. This extract, thus obtained, after being concentrated by distillation, is ready for use. A hundred parts of root yield from 2 to 3 per cent of purpurine, and 4 or 4½ per cent of alizarine.

The second process, that of Professor Emile Kopp, is based on another discovery of Dr. Schunck, namely, that weak acids act upon rubian in the same manner as erythrozym, unfolding it into sugar and alizarine. M. Kopp found, some years since, that sulphurous acid dissolved the glucosides of purpurine and alizarine, and applied this observation as follows:—600 lbs. of Alsace madder are macerated for 12 or 15 hours with 800 gallons of a weak solution of sulphurous acid, to which is added one-thousandth part of hydrochloric acid, to neutralise the earthy carbonates existing in the root. This operation is repeated three times. To the liquors 3 per cent of sulphuric acid are added, and the whole heated to a temperature not exceeding 140° F., when red-coloured flakes separate and gradually deposit, which, when washed and dried, are commercial purpurine. The liquor is then carried to the boil for a couple of hours, and allowed to cool, when a dark green powder is found deposited in the vessels, which, when washed and dried, is commercial alizarine.

This process has been carried out by Messrs. Schaaffer and Lauth for many years, and no doubt yields a larger amount of colour-giving principle than M. Leitenberger's method, the glucosides being doubtless more completely decomposed by the acids than by water alone. It has the further advantage of obtaining the colouring matters free at once, which have only to be washed to be ready for use.

The dyeing power of the alizarine thus obtained is equal to 40 times its weight of madder, or 10 times that of garancine. These colouring substances, except green alizarine, are not substituted for madder in the dyebeck,

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but are printed on the cloth and steamed, as will be described further on.

M. Kopp found that his green alizarine is a mixture of alizarine with chlorogenine, and that this latter body can be separated by treating the mixture with a light oil of tar, having a boiling-point of 300°, which dissolves the chlorogenine. Alizarine is employed in the production of rich purples, whilst purpurine is used for reds and pinks.

Before describing pure alizarine and purpurine, I may state as a fact very interesting, although of no commercial value, that if superheated steam be passed over a preparation of madder known as garancine, pure alizarine is volatilised, and may be easily collected.

Pure crystallised alizarine was discovered, in 1824, by MM. Robiquet and Colin, by treating madder with strong sulphuric acid, when they produced a black mass, which they called *Charbon de garance*, and which, on being heated at a moderate temperature, yielded crystals of alizarine.

In 1851, Dr. Schunck succeeded in isolating from madder a substance to which he gave the name of *Rubian*. This he effected by filtering a hot decoction of madder on pure animal black, which is washed with cold water to remove chlorogenine. The washed charcoal is boiled repeatedly with alcohol, and the alcohol solution evaporated to dryness. The dry mass is dissolved in water, and acetate of lead added, which gives rise to a precipitate. This precipitate, when acted on by sulphuretted hydrogen, gives pure rubian in solution. When rubian is acted on, either by erythrozym or weak acids, it is decomposed, yielding, according to Dr. Schunck's paper, alizarine and water; according to M. Schützenberger, alizarine and glucose, or grape sugar.

Pure alizarine sublimes, at a temperature of 460° F., into pale orange prismatic crystals. When slowly crystallised from an ethereal solution, it forms a hydrate, containing two equivalents of water, which crystallises in lustrous scales. Cold water dissolves a mere trace of alizarine, but its solvent power increases as the temperature is raised, as may be seen from the following figures:—

At 212°	100 parts of water dissolve	..	..	0·034
At 490°	,,	,,	.. ..	0·820
At 480°	,,	,,	.. ..	3·160

Alizarine is freely soluble in alcohol, ether, wood spirit, benzole, turpentine, sulphuret of carbon, and glycerine. It is soluble without decomposition in sulphuric acid, even at a temperature of 400° F., and is thrown down unchanged when large quantities of water are added. It is soluble in a warm solution of alum, but insoluble in a cold one. It has been assigned different formula by different chemists, the two most generally adopted being that of Dr. Schunck, $C_{14}H_{10}O_4$, and that of Wolf and Strecker, $C_{20}H_{12}O_6$. Alizarine gives a purple colour with a weak solution of caustic alkali, which undergoes no change by the action of air. It yields, with alumina fixed on fabrics, a variety of red and pink shades; with oxide of iron it gives purples and blacks; and, with a mixture of these two oxides, chocolates.

I shall now call your attention to one of the most interesting and important discoveries of chemistry, as applied to manufactures, which have been made of late years, namely, the artificial production of this most important colour-giving principle, alizarine, or of a substance which—if not identical—has great similarity to it. Messrs. Graebe and Liebermann, and Mr. Perkin, believe in the identity of the artificial product with the natural one. But this is denied by M. Alfraise, on the grounds, first, that the formula given by Messrs. Graebe and Liebermann does not agree with that given by Dr. Schunck, as is shown by the following figures:—

Schunck.	Graebe and Liebermann.
$C_{14}H_{10}O_4$	$C_{14}H_8O_4$.

Secondly, that the artificial alizarine does not give the same coloured sublimate as the natural alizarine; and thirdly, that if both these substances are acted on by nitric acid, natural alizarine is converted into phthalic acid, whilst the artificial alizarine, which he calls alizapurine, yields a large quantity of a nitro-compound having an intensely bitter taste, mixed with only a mere trace of phthalic acid. These observations of M. Alfraise have been confirmed by M. Kopp. That the commercial artificial alizarine is not identical with a natural alizarine is rendered still more certain by the researches of Dr. Schunck, who, on examining a sample obtained from Mr. Perkin, found it to contain a large quantity of a compound crystallising in yellow, silky needles, anthraflavic acid, and which he obtained by treating Mr. Perkin's product with alcohol. On treating the acid with fuming nitric acid he obtained a nitro-compound, the potash salt of which he describes as resembling picrate of potash. This is doubtless the bitter principle which Alfraise obtained, but did not study. Dr. Schunck gives the formula of anthraflavic acid as $C_{15}H_{12}O_4$, and considers it homologous to alizarine, one equivalent of its hydrogen being replaced by methyl. Messrs. Graebe and Liebermann, and Mr. Perkin, found their opinion as to the identity of the two alizarines on the fact that they give the same absorption-bands on being submitted to Professor Stokes's spectrum test.

Artificial alizarine was first made in 1869, by Messrs. Graebe and Liebermann. The substance from which they obtain it is *anthracene*, a body discovered by Professor Anderson, of Glasgow. Anthracene is one of the last products passing over in the dry distillation of coal-tar, and is found most abundantly in the 10 or 15 per cent which comes over from the temperature where soft pitch is formed and that where hard pitch is produced. The quantity of anthracene in coal-tar varies greatly; it is most abundant in the tars obtained from those coals which yield most naphtha. The South Staffordshire coals give the largest quantity, whilst the Newcastle coals give very little. Its extraction can only be carried on with advantage in cold weather, as it becomes very soluble on a slight rise of temperature in the oily homologues which accompany it. At a temperature of about 40° the distillate above described is semi-fluid; it is placed in a hydro-extractor, and the oily fluid separates from the solid matter, which is then submitted to cold and hot pressure. The cake thus formed is pulverised and carefully washed with petroleum spirit, having a boiling-point of about 180°, which leaves anthracene moderately pure. This powder, dissolved in alcohol and crystallised, yields anthracene in nearly white scaly crystals, or in a fit state for the manufacture of artificial alizarine.

Messrs. Graebe and Liebermann oxidised the anthracene ($C_{14}H_{10}$) by nitric acid, into anthrachinon ($C_{14}H_8O_2$), this being again converted into bibrom-anthrachinon ($C_{14}H_6Br_2O_2$), which, by fusion with potash, is changed into alizarine ($C_{14}H_8O_4$). There are three patents published, and a process, the details of which are kept secret. It is curious to notice that the patent taken out by the above-named gentlemen and M. Caro is dated June 25th, 1870, while Mr. Perkin entered his on the day following, in which nearly the same processes are described, merely employing different oxidising agents.

The following is an outline of one of the processes detailed in the specification of MM. Caro, Graebe, and Liebermann:—1 part of anthracene is heated with 4 parts of sulphuric acid, of sp. gr. 1·845, for 3 or 4 hours, to a temperature of 212° F., and then for 1 hour at 300°. The mixture is allowed to cool, and to it is added water equal to 3 times the weight of anthracene taken, and manganese equal to 4 times that weight. The whole is boiled for 3 hours, and a milk of lime is then added, which gives rise to a deposit, consisting of the excess of lime and manganese used, and protoxide of manganese, while there remains in solution a double sulphate of anthrachinon and lime. This solution is now acted on by car-

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bonate of soda in slight excess, carbonate of lime separates, and the salt of soda thus produced is evaporated to dryness. To this solid mass is then added 2 or 3 parts of caustic potash or soda and a small quantity of water, and the whole heated under pressure, in suitable vessels, at a temperature of 350° to 500° for 1 hour, when the anthrachinon is further oxidised, and converted into alizarine. This anthracene, $C_{14}H_{10}$, gives anthrachinon, $C_{14}H_8O_2$, and this alizarine, $C_{14}H_8O_4$. The alkaline mass, on cooling, is dissolved in water, and sulphuric or acetic acid added in slight excess, when an orange-yellow flocculent substance precipitates, which, when properly washed and dried, is artificial alizarine.

The second colour-giving principle of madder, to which I have referred several times already, is called purpurine, and was also discovered by MM. Robiquet and Colin, in 1828. Although in commerce it is sold as a red powder, as has been mentioned above, still, by heating at a temperature of 480° F., it can be obtained in the form of feathery crystals, of an orange-red colour. It is more soluble in water than alizarine, especially at a temperature of 140° F., and is also soluble in the menstrua already mentioned under alizarine. Further, it gives a red colour with caustic alkali, instead of purple as alizarine. It is soluble in a cold solution of alum, while alizarine is not. When fixed on fabrics, its colours do not stand exposure to light as well as those of alizarine.

Professor Stokes, of Cambridge, has found a most elegant method of discovering and characterising mere traces of these colouring principles. So delicate is the test, that the colouring matter on 1 square inch of dyed fabric is sufficient to obtain the results. He treats the fabric with a solution of carbonate of soda, which dissolves the colouring matter. The solution is then introduced into a small tube, which is placed before a slit in the shutter of a dark room. The light which passes through is decomposed by a prism, when a spectrum is produced. The operator will observe that, when purpurine is taken, there are principally two black bands formed by the absorption of light in the green part of the spectrum, having between them a band of green light, whilst alizarine exhibits, on analysis, a band of absorption in the yellow, and another narrower one between the red and the orange.

Professor Schützenberger, by treating commercial purpurine successively with alcohol and benzine, unfolded it into four different substances, to which he assigns the following formulæ:—

Alizarine	$C_{20}H_{12}O_6$.
1. Purpuroxanthine	$C_{20}H_{12}O_6$, or $C_{20}H_{14}O_6$.
2. Purpurine	$C_{20}H_{12}O_7$, or oxy-alizarine.
3. Orange matter ..	$C_{20}H_{16}O_9$, or hydrate of purpurine.
4. Pseudopurpurine	$C_{20}H_{12}O_9$, or oxy-purpurine.

(To be continued).

CORRESPONDENCE.

ERNEST THEOPHRON CHAPMAN.

To the Editor of the Chemical News.

Sir,—Mr. E. T. Chapman, whose name is so well known to your readers and to the whole scientific world, was killed by an explosion in his laboratory at Ruebeland, in the Harz, on the 25th of June last. He appears to have been engaged of late in the manufacture of nitrate of methyl (called by the correspondent "salpetersäure methyl-æther"). Mr. Chapman, in one of his letters, describes the substance with which he was working as useful for blasting purposes, but remarkably difficult to explode, and indeed capable of being burnt like alcohol, without explosion.

The "bomb-proof" building in which Mr. Chapman *and three* workmen were engaged was blown up with a terrific noise. All in the building were instantly killed. The surrounding buildings were injured, and ten other people were dangerously wounded. Nothing of course is known of the immediate cause of the explosion. Surely our experience is now sufficient for us to distrust explosives containing hydrogen and nitrogen oxides. And surely a "bomb-proof" building is the worst kind of building for storing explosives of any kind.

All who have the progress of chemistry sincerely at heart, will grieve that this man of great performance and boundless promise has been thus removed from us. Though Mr. Chapman was only twenty-six years of age, few living chemists have contributed more abundantly to organic chemistry, and his originality was as great as his skill and devotion.

Mr. Chapman had many opponents. No one worth his salt has not. But I do not think that there is one among even these who will not grieve at his death. A kinder, a gentler, a more generous heart never beat than the one which is now at rest beneath the pine woods of the Harz.—I am, &c.,

Frederick Guthrie.

PROPOSED ASSOCIATION OF MANUFACTURING CHEMISTS.

To the Editor of the Chemical News.

Sir,—I was very much interested in the letter of your correspondent "Frank" respecting the formation of an Association of Manufacturing Chemists. He will probably be gratified to hear, that in at least one of the great centres of chemical industry, the nucleus of such an association already exists. I refer to the "Tyne Social Chemical Society," a private association of the managers and chemists of nearly all the principal chemical works of Newcastle-on-Tyne and its neighbourhood. It has been established for the purpose of promoting a scientific and friendly intercourse among the practical chemists of the district. This is effected—first, by the reading and discussion of papers on manufacturing subjects; secondly, by conversations which are started on questions of practice arising from time to time, and which are frequently the means of eliciting the most valuable information.

We meet once a month in a very informal way, and except during the reading and discussion of the papers, our proceedings are carried on in little groups of twos and threes, discussing the last new thing in chlorine, the progress of A.'s new chambers, or B.'s break down, or C.'s new pumping engine.

It is surprising what an amount of solid information is exchanged at these meetings, the fact being that since almost every manufacture of the district is represented by one or more of its managers, you can get information upon any subject you want. Of course there is a certain etiquette observed in any process which is considered private, but these processes are so few that we have had but little difficulty on this head. We have discussed the manufacture of oil of vitriol in every minute detail, the Weldon process, the manufacture of soda-ash, kelp, ammonia, the economy of fuel, construction of pumps, boilers, and engines, incrustations, and a hundred other subjects, upon every one of which some one or more members could give the most useful practical information arising out of his own experience.

If the managers of other districts would form associations of this kind, I can assure them from my own experience and of the members of our society, that an incalculable amount of good would arise out of such genial association.

Hundreds and thousands of pounds might, as your correspondent observes, be saved by an intercourse of the managers of a district who would be most willing to communicate many of their experiences which they have no object in keeping to themselves.

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That your correspondent may judge of the quality of our papers, I send you three in which he may probably feel interested, the first being the results of working the Weldon process at one of the largest manufactories on the Tyne; the second is on the manufacture of oil of vitriol and soda-ash by a thoroughly practical manager; and the third is an account of the construction of a chemical works erected in Ireland by the author of the paper, accompanied by a complete set of plans and sections, which have been photographed and distributed to the members.

Now, Sir, I contend that if societies like these were formed in various manufacturing districts, we could easily form an Association of Manufacturing Chemists, holding an annual gathering as "Frank" proposes.

I don't see why a commencement should not be made this autumn.

If any of your correspondents feel sufficient interest in the matter, I shall be happy to give them any further information about the above-named society, and I am sure the chemists of Newcastle will be most happy to greet their professional brethren here, if they will make this town the scene of the first meeting of the Association.—I am, &c.,

WILLIAM CROWDER,
Hon. Secretary Tyne Social Chemical Society, Manager of Langdale's Chemical Manure Co. (Limited), Newcastle-on-Tyne.

P.S.—As to the use of Coffey's still in the manufacture of ammonia, if your correspondent refers to vol. i., pages 180 and 181 of Muspratt's "Chemistry," he will find that it is an expired patent by Newton (1841), and there are some particulars which may prove useful to him.

ANALYSES OF MANURE.

To the Editor of the Chemical News.

SIR,—Annexed is copy of analysis, made by a public analyst, of a sample of dissolved bones taken from the stock of a well-known manufacturer. The sample is said to contain *nitrogen* equal to 3·57 of ammonia. No mention is made of the addition of ammoniacal salts. It appears to me that there is here an exceptionally high amount of ammonia for so-called "dissolved bones," especially as I understand there is no such thing as pure dissolved bone manure. If manufacturers do not dissolve some mineral phosphates along with the bones, they must use a large quantity of some article to dry them up after dissolving. But assuming that in this case the bones (pure) contained 4 per cent of ammonia, and that nothing was added except acid, either before or after dissolving, is it possible that the manure should contain 3·57 per cent of ammonia? If it cannot in the circumstances stated, then it is certain it cannot after the indispensable "dry" has been added.

Will any of your numerous readers be good enough to give an opinion on this point in an early issue.—I am, &c.,

MANURE.

June 14, 1872.

Copy of Analysis.

	Per cent.
Moisture	11·73
*Organic matter	24·57
†Biphosphate of lime	10·64
Insoluble phosphate	21·72
Hydrated sulphate of lime	26·14
Alkaline salt	4·00
Sand	1·20
	100·00

* Yielding nitrogen equal to ammonia, 3·57.
† Equal to bone asphalte made soluble, 16·86.

DENDRITIC SPOTS ON PAPER.

To the Editor of the Chemical News.

SIR,—Since I was unavoidably absent from the meeting of the Chemical Society held on Thursday, June 6, perhaps I may here be permitted to reply to Dr. Müller's remark upon my note on "Dendritic Spots on Paper," in which paper I show that the majority of such spots have an inorganic and not a vegetable origin, as was formerly supposed, and that they arise from small metallic particles present in, or adherent to, the surface of the paper.

Dr. Müller commented on the paper, and said "he had long ago observed these dendritic marks and knew them to be caused by portions of the bronze detached from the paper-making machinery." (*Vide* CHEMICAL NEWS, June 14, 1872).

Now, in 1869, when proceeding with the investigation of these spots, I wrote to Messrs. De la Rue and Co., asking them to kindly supply me with a quantity of paper containing such markings, of which I enclosed specimens, mentioning, I believe, in my letter the purpose for which I required it, and stating that I had found copper present in these dendritic spots, but had not at that time ascertained its state of combination, and therefore wished for a supply of material to enable me to do so.

In reply, I received a very courteous note from Dr. Müller, as follows:—

"110, Bunhill Row, E.C.,
July 5, 1869.

"Sir,—Your letter, dated 24th June, is to hand this morning. With regard to the spots you refer to, I would mention that this defect occurs sometimes with the paper, and it appears to me to be caused by being kept in a damp place, which condition favours the peculiar *fungoid growth* to which I ascribe these marks. I have none of this kind of paper at present at my disposal, but search is being made for it at my order, and should it be successful I shall be happy to forward you some for your investigation.—I am, Sir, your obedient servant,

"HUGO MULLER."

Hence it is evident that at that date Dr. Müller regarded the spots as vegetable growths, and has since modified his views in accordance with the communication which I made to him.

The dendritic markings mentioned by Messrs. Friswell and Spiller as occurring on prepared albumenised paper must have been noticed by everyone who has anything to do with such prepared paper; but then these markings bear no very near relation to the ordinary dendritic spots found on paper, for the former consist of metallic silver reduced by particles of some metal, such as iron, copper, &c., and the silver has crystallised out in an arborescent form, while the latter consist mainly of copper in combination with sulphur.—I am, &c.,

ARCHIBALD LIVERSIDGE.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Annalen der Chemie und Pharmacie, No. 8, 1872.

This number contains the following original papers and memoirs:—

Hexyl-alcohol Obtained from Heracleum Oil, and on the Capronic Acid Prepared from it.—A. Franchimont and Th. Zincke.—After first briefly referring to Dr. Wohler's researches on this

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subject, the authors state that they received about 200 grms. of the essential oil of an heracleum species (probably the *Heracleum giganteum*) grown in the Zoological Gardens in London, the oil being distilled there from the fruit of the plant alluded to. It appears that this oil consists of acetic acid octyl ether and butyric acid-hexyl ether, two isomeric ethers which can be separated from each other by fractional distillation. This memoir also treats on—Hexyl-alcohol, $C_6H_{14}O$, a colourless liquid insoluble in water, exhibiting a strongly aromatic odour, boiling at 156·6°; sp. gr.,0·819; on being oxidised this alcohol yields a fatty acid of the formula $C_6H_{12}O_2$. Hexyl-iodide, $C_6H_{13}I$, a liquid insoluble in water, boiling at 179·5° at 752·46 m.m. barom.; sp. gr. 1·4115. Hexyl-acetate, $C_6H_{13}O.C_2H_3O$. Hexyl-capronate, $C_6H_{13}O.C_6H_{11}O$. Capronic acid, $C_6H_{12}O_2$, an oily fluid, remaining liquid even at −6°, boiling at 205°. Capronic acid ethyl-ether, $C_2H_5O.C_6H_{11}O$, a pleasant smelling fluid: sp. gr. 0876 at 17·5°, boiling at from 164·5° to 165·9°. Capronate of baryta—

$$Ba(C_6H_{11}O_2)_2 + H_2O.$$

A large portion of this lengthy essay is devoted to the discussion of the question of the relation existing between the hexyl alcohol alluded to, its derivatives, and other bodies of similar composition.

Gallic Acid and Gallic Acid Ether.—H. Schiff.—The author refers to his former researches on this subject, and also to the researches of others, more particularly to those of Nachbaur, who stated that by treating gallic acid with chloracetyl there should be formed tetracetyl-gallic acid. According to the author this is not correct; on repeating the experiment the author obtained a body which, on being analysed, led to the formula—

$$C_6H_2\begin{cases}CO.OH\\O.C_2H_2O\\O.C_2H_2O\\O.C_2H_2O\end{cases}$$

that is to say triacetyl-gallic acid; with chlorbenzoyl (which corrodes glass rapidly) gallic acid yields tribenzoyl-gallic acid, a resin-like material, which becomes soft at 85°; formula:—

$$C_6H_2\begin{cases}CO.OH\\(O.C_7H_5O)_3\end{cases}$$

Gallic acid ether; the formula of the lead salt of this body is—

$$\left.\begin{matrix}C_7H_3(C_2H_3)O_3\\C_7H_3(C_2H_3)O_3\end{matrix}\right\}Pb_2''$$

Anhydrides of Salicylic Acid.—H. Schiff.—Notwithstanding the intrinsic value of this memoir, its contents, elucidated by a series of very lengthy and complex formulæ, are not suited for abstraction.

Action of Phosphorus Oxychloride upon some Acids.—H. Schiff.—It appears that when the oxychloride alluded to acts upon acids, most of these, including even concentrated sulphuric acid, are decomposed, while metaphosphoric acid is formed; when the oxychloride is made to act upon phenolsulpho acid the result is the formation of anhydride of two molecules of the sulpho acid—

$$2C_6H_6SO_4 - H_2O = C_{12}H_{10}S_2O_7.$$

New Nitro Acid.—H. A. Kullhem.—The author gives a detailed account of the mode of preparation of dinitro-heptyl acid, the result of the very prolonged action of boiling nitric acid upon camphor. The acid alluded to, $C_6H_{10}(NO_2)_2O_2$, is a solid body, slightly soluble in water, crystalline, readily soluble in alcohol and ether; volatile at 100°, fusible at 215°, but with decomposition. The salts of this acid detonate when heated to 150°; most of the salts are crystalline bodies.

Researches on the Inorganic Constituents of Blood.—A. Jarisch.—The first instalment of an exhaustive monograph on this subject. This portion, elucidated by a large number of tabulated formulæ exhibiting results of experiments, treats on the blood of dogs. The temperature of the body of the dogs seemed to show that they were in a healthy condition.

Analysis of the Meteoric Iron of Ovifak in Greenland.—Dr. F. Wohler.—This is an exhaustive essay on the best and most expeditious methods of analysis of these minerals. The composition of the meteoric iron of Ovifak is percentically quoted as—Iron, 80·64; nickel, 1·19; cobalt, 0·47; phosphorus, 0·15; sulphur, 2·82; carbon, 3·69; oxygen, 11·09; total, 100·05.

Notice on Tyrosin.—L. Barth.—This brief paper contains some observations on the researches on tyrosin made by Beilstein, Kuhlberg, Glaser, Piria, and others. The author thinks that the synthetical composition of tyrosin has not yet been accomplished.

Bulletin de la Societe Chimique de Paris, No. 8, April 15, 1872.

The only original paper contained in this number treats on the—

Action of Iodide of Lead upon some Metallic Acetates.—D. Tommasi.—According to the reactions which take place between these two bodies, the acetates can be divided into three groups, viz.:—Such as combine with plumbic iodide (only acetate of potassa belongs to this group); acetates which, while reacting upon plumbic iodide, give rise to phenomena of double decomposition (diacetate of copper and acetate of mercury); acetates which act upon iodic plumbic simply as solvents (for instance, acetates of soda, ammonia, iron, &c.). The formula of the combination of plumbic iodide and acetate of potassa, also termed plumbic iodacetate-aceto-potassic, is—

$$\left[\left(\begin{matrix}(C_2H_3O)_2\\Pb''\end{matrix}\right\}O_2\right), I_2Pb'', \left.\begin{matrix}C_2H_3O\\K\end{matrix}\right\}O\Big] 3\left(\begin{matrix}H\\H\\H\end{matrix}\right\}O\Big)^*$$

or—

$$\left[2\left(Pb''\left\{\begin{matrix}[O(C_2H_3O)]'\\I\end{matrix}\right)\right.\left.\begin{matrix}C_2H_3O\\K\end{matrix}\right\}O\Big] 3\left(\begin{matrix}H\\H\\H\end{matrix}\right\}O\Big)$$

* O=16; C=12; Pb=207.

This memoir abounds with formulæ, while it also contains an account of the mode of preparation of the various salts and bodies described. Acetate of soda appears to be an excellent solvent for plumbic iodide.

Le Moniteur Scientifique Quesneville, No. 366, June, 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral subjects:—

New View and Practical Observations on Typhus, Yellow Fever, Intermittent Marsh Fevers, and Peruvian Scorbut (Verrue Péruvienne).—Dr. M. C. Tasset.—A valuable contribution to the science of medicine, more especially in relation to the climate of Peru.

Crystallised Aconitine.—M. Duquesnel.—This essay relates to the history of the discovery of aconitine, and to the researches made on *Aconitum napellus*, by Steinacher (1808), Brandes (1819), Hesse (1833), von Planta Reichenau, Hottot, Grove, and others (the last-named author appears to have been the first to obtain crystallised aconitine). A lengthy account is given of the mode of preparing this substance, the formula of which is $C_{66}H_{40}NO_{12}$. From 0° to 100°, either in the presence or absence of water, heat has no action upon crystallised aconitine; it is almost insoluble in cold and boiling-water, and is partly decomposed and partly volatilised at 130°. It is soluble in alcohol, ether, benzine, and especially in chloroform; insoluble in glycerine, and light, as well as heavy, petroleum oils. Solutions of aconitine exhibit a feeble alkaline reaction to test-paper, while the alkaloid forms, with acids, salts which readily crystallise. Phosphoric acid, tannin, iodide of potassium, and the double iodide of potassium and mercury are the most sensitive chemical reagents for this alkaloid, the detection of which, according to the author, has to be aided by physiological experiments. A large part of this paper is devoted to the pharmaceutical preparations of aconite and aconitine.

On Fermentations: Examination of the Latest Discussions on this Subject as treated by Drs. J. von Liebig, Pasteur, and Fremy.—Dr. C. Blondeau.—Notwithstanding the intrinsic merits of this very exhaustive and lengthy memoir, its contents are not suited for abstraction. Incidentally, the author observes that Becher (1670) has been the first to observe some kind of analogy to exist between combustion and fermentation.

Note on the Analysis of Soaps.—F. Jean.—Reserved for full translation.

Les Mondes, June 27, 1872.

This number contains no original matter relating to chemistry, but we call attention to the following paper:—

Labours of the Italian Spectroscopistic Society.—M. Tarry.—A condensed account of the observations made at the astronomical observatories of Italy in relation to the sun.

Revue Universelle des Mines, de la Métallurgie, des Travaux Publics, des Sciences et des Arts Appliquées à l'Industrie, Nos. 1 and 2 (double number), 1872.

In addition to several important original papers bearing upon engineering, mechanical, and metallurgical subjects, this number contains the following original paper relating to chemistry:—

Water of Hatray, near Spa, Belgium.—T. Kupfferschlaeger.—The author states that, in a rather secluded locality opposite to the village of Sart, there constantly issues from the rocks an abundant quantity of water, which forms a rivulet at the base of the rocks and flows along the embankment of the railway, finally entering a large watercourse. It appears that this water, which hardly tinges blue litmus-paper red, is not rendered turbid by ferrocyanide of potassium, carbonate of ammonia, salts of baryta, or oxalate of ammonia; it contains only 0·05 grm. of solid matter to the litre, and is therefore well suited for domestic and industrial purposes. At present this water is turned to no use at all, while (especially for paper-making and other industrial applications) it is of great value, being far purer than most natural waters, excepting some met with in Sweden, Spain, and Switzerland.

La Revue Scientifique de la France et de l'Etranger, June 29, 1872.

This number contains no original papers relating to chemistry, but there is the concluding lecture on—

Animal Heat and the Influence of the Sympathetic Nervous System upon the Circulation of the Blood.—Dr. C. Bernard.

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THE CHEMICAL NEWS.

VOL. XXV. No. 659.

ON FERRO-TUNGSTINE,* A NEW AND INTERESTING MINERAL.

By HUGO TAMM.

SOME years since, a sample of a very remarkable mineral came to my hands. I was then unable to find out the place where it was originally discovered; and as I have not been any more successful since in my attempts to trace it to its source, I publish the result of an incomplete investigation of this substance, in order to call attention to it and rescue this really interesting mineral from oblivion.

The sample I had in my possession was so very small that this must be my excuse for not giving a fuller account of its composition and properties; but, with the description which I am going to give of it, it will be very easy to pick it out wherever it exists, whether along with other minerals, in mines, or among unexamined specimens in museums.

Ferro-tungstine is a dark steel-coloured, heavy, crystalline powder, formed of separate and distinct crystals, presenting exactly the appearance of crystallised silicium. Its specific gravity, which is considerable, is 12·5. It is a very hard substance, which can only be porphyrised with extreme difficulty, and it is almost impossible to reduce it to an amorphous powder; the powder obtained after a prolonged porphyrisation remaining still bright, like the powder of a crystalline metal or alloy, and crystalline.

Heated in the air at a low red heat, ferro-tungstine slowly oxidises, and is converted into a yellow powder of tungstic acid; and when it is thrown in fused nitre, it burns with brilliancy and is thoroughly attacked.

Ferro-tungstine is composed of—

Metallic tungsten	88·05
Metallic iron	5·60
Metallic manganese	0·15
Undetermined substance	6·20
	100·00

I have no reason whatever to doubt the accuracy of the estimations of tungsten, iron, and manganese, which were repeated twice over with identical results, and I am quite at a loss to imagine what the undetermined substance may be; but this of course will easily be ascertained as soon as larger samples of the mineral are found.

It is not oxygen, for ferro-tungstine heated in a current of hydrogen does not lose any portion of its weight; nor does it when heated at a very high temperature in a carbon crucible. And yet the hypothesis of oxygen was very tempting, when we consider that, had the undetermined substance been oxygen, tungsten would have existed in the state of a new oxide—a suboxide.

The hypothesis of sulphur was equally fascinating, for in that case tungsten would exist as a new sulphuret—a subsulphuret; but ferro-tungstine does not contain a trace of sulphur.

It may be phosphorus, but it is not arsenic, and I do not believe that it is a metallic substance. What is it then?

If I had been absolutely certain of the specific gravity of ferro-tungstine to the third decimal, I might easily have calculated the specific gravity of the undetermined substance, and I might easily afterwards have verified the indications given by specific gravity; but, although the specific gravity, 12·5, which I give is sufficiently correct for any practical purpose, I do not feel justified in forming any conclusions based upon it.

It is possible that the undetermined substance is hydrogen, or rather hydrogenium; in which case ferro-tungstine would really be a most remarkable mineral, being the first example of a native alloy of hydrogenium; but I had exhausted the small sample on which I operated when the thought struck me that it might be so.

It is possible, also, that nitrogen is the substance in question, or that it is a new element.

Lastly, it may be after all an analytical error, and there may be 6·2 per cent more tungsten than shown by the analysis, but I have strong doubts on that point.

But, as soon as ferro-tungstine is found anywhere, any obscure point of its history will soon be cleared by myself or by others.

* Mr. Tamm has done me the honour to propose that this mineral shall be called either "Crookesite" or "ferro-tungstine," and has left the decision to me. The name Crookesite having already been used by Nordenskjold to designate a mineral containing a large quantity of thallium, I am unable to accept the honour proposed by Mr. Tamm, and have accordingly adopted the second name. At the same time, I would propose that the more appropriate name "Tammite" should be employed for this curious mineral as soon as the missing constituent is identified.—W. CROOKES.

CUTANEOUS ABSORPTION.

IN a recent note to the Paris Academy, M. Bernard writes as follows:—

I desire to submit to the Academy an account of experiments made in the Vincennes Asylum as to cutaneous absorption in baths of medicamental vapour. In such an institution, among patients with various chronic affections, I am favourably situated for experimenting on this question on a large scale.

Reveil's memoir on the subject gives the facts which are known up to the present. "Absorption in the bath," he says, "only takes place in rare and exceptional circumstances; it is facilitated by washing the skin, continued rubbing, and by certain irritant and solvent substances."

The bath apparatus consisted of a furnace, a boiler, a chamber in which the steam coming from the boiler was charged with the substance to be applied, and a wooden cage, in which the patient was seated while enveloped in the vapour.

I used iodide of potassium in my experiments—(1) because it is not volatile; (2) because its presence in urine is easily determined by nitric acid and chloroform; (3) because, in seizing the iodine set at liberty by the nitric acid, the chloroform takes a rose colour varying in a marked way with quantity, and thus, by comparing with a graduated scale, one may determine pretty accurately, and without quantitative analysis, the quantity of iodide of potassium in the urine.

The skin of the subjects experimented on was intact, without wound or scratch. The urine was examined before the bath was taken, and the absence of iodine ascertained. By a respiratory tube, the patient breathed the external air through his mouth, the nostrils being pinched. A thick sheet of caoutchouc was bound by a T-bandage over the anus; the penis was sheathed in the same material; while the hands and feet were wrapped in cotton and gummed taffeta.

The subject was then placed in the cage, and subjected for thirty minutes to vapour from the mixing chamber, into which there had been put 20 grms. of iodide of potassium. The temperature in the cage was gradually raised to 45°; the skin of the subject became wet. He was then wrapped in a woollen covering and put in bed, when profuse perspiration took place. The urine analysed two hours after the bath gave a rose colour: some taken three hours after gave a much more lively colour; thus affording clear proof of the absorption of iodide of potassium through the skin, the only way it could have entered the system. Besides, if it had entered by pulmonary passages it would have been eliminated immediately after the bath.

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These first experiments, then, prove the fact of cutaneous absorption.

In a second series I sought to determine to what temperature the air, mixed with medicamental vapour, must be raised, in order to the absorption taking place.

A very sensitive thermometer was applied to the breast of the subject, and the temperature of the bath varied in the series of experiments from 30° to 38°, the time being, as before, thirty minutes. I only found the absorption take place when the temperature was 38° (or one degree above the temperature of the body). Indeed, the sebaceous matter in the cells of the epidermis only commences to dissolve at 38° when the skin is really wet; it is then that imbibition takes place, and consequently absorption. The iodide of potassium, conveyed mechanically by the vapour, penetrates the epidermis, whence it passes into the capillary blood system and the other organs.

Thus we understand how absorption does not generally take place in a water-bath. Owing to the density of the water, and its great specific heat, the temperature of such baths is usually not raised beyond 30° to 33°. Dr. Homolle remained in a bath at 34° or 35°; would he have been able to bear 38° or 39°? Besides, the liquid layer touching the skin is not constantly renewed, as in the vapour-bath.

I succeeded, however, in obtaining the cutaneous absorption at a temperature under that of the body, in the following way:—

The subject had first a simple vapour-bath, to destroy the sebaceous matter; his skin was washed and carefully dried, and he was replaced immediately in the cage, where he was exposed to the vapour of iodide of potassium for thirty minutes, the temperature of the bath varying, in several experiments of this kind, from 34° to 36°. Two hours after a bath at 34° the colouration of the urine was slightly rose; after a bath at 36° it was much more distinct.

M. Colin has described an experiment in which he allowed water charged with cyanide of potassium to fall for five hours' time on a horse's back. This caused the death of the animal; the sebaceous matter having been destroyed through percussion, and cutaneous absorption taking place.

In the sand-baths at Cette and Arcachon, which are found so efficacious for scrofulous affections, tumours, &c., what takes place? The temperature being considerably above that of the body (over 40°), the skin is wet, the sebaceous matter dissolves in the perspiration, and there follows absorption of the salts contained in the sand.

I have not been able to find free iodine in the urine; the use of nitric acid has always been necessary. Besides. iodine once introduced into the system soon forms various compounds.

In summing up his results, M. Bernard further mentions that the elimination of the salt, commencing two hours after the bath, increases in quantity till a meal is taken, after which it diminishes (probably because of the water received into the system), and then again increases. It ceases completely twenty-four hours after the bath, whatever the amount of the salt, the temperature, or the duration of the bath.

A. B. M.

ON THE CONSTITUTION OF MILK AND BLOOD.

By M. DUMAS.

During the most troubled years of the first French revolution, the old Academy of Sciences of Paris having been suppressed, its members none the less continued their patriotic co-operation in the labours required by the new necessities of the country. History has given them credit for this. It associates the names of the principal of them with those of the illustrious administrators and generals, who then caused the integrity of the French soil to be respected.

The editors of the *Annales de Chimie*, who had been compelled to suspend their publication under the reign of Terror, on resuming it had the happy thought of collecting, in two volumes, all the memoirs or reports with which the Academicians had been charged. In running through these we appreciate at a glance the importance of the questions which were addressed to them, the insufficiency of the means at their command during those troublous times, and the merits of the practical solutions which they presented to the country, as the fruit of their previous studies, or of their improvised experiments.

Saltpetre, gunpowder, steel, weapons, gun-metal, potash, soda, soaps, paper, assignats, and many other objects implicated in the defence of the country, the working of its manufactures and the necessaries of life, gave occasion to investigations and discoveries of which the factories have not yet forgotten the tradition.

The siege of Paris by the Prussian army could not, it was said, be sufficiently prolonged to raise any questions of the same kind; but nevertheless it has been necessary, as in the time of our fathers, to seek for nitrated earths, to produce gunpowder, to manufacture and work up steel, to obtain bronze and cast cannon; we have also been in want of paper, and of a great number of useful objects.

Considerable, although rapid, investigations have been accomplished; and it will be useful as well as just not to allow their memory to be lost. I have busied myself in collecting the materials for this publication, which I shall carry out as soon as circumtances will permit.

Among the privations which our forefathers did not know in their most cruel intensity, those which caused the most decided sufferings to the existing population, relate to the want of combustibles, which was rendered intolerable and most destructive by an exceptionally rigorous winter—to the scarcity of milk and eggs, the certain cause of the premature decease of a great number of young children—and, finally, to the exhaustion of the supplies of corn, flour, and meat, which, rendering the capitulation of Paris inevitable, marked the precise day for it.

Three questions, which have occupied the mind of every man curious to foresee the future of science, were thus incessantly presented to the meditation of the scientific men shut up in Paris, not as far-away dreams in which the imagination delights and disports itself, but as the despairing prayers of a people in utter extremity:—

1. To obtain available heat, without combustibles;
2. To re-construct food with mineral materials, without the co-operation of life;
3. To reproduce, at least, the essential food of man with non-alimentary organic materials.

Man, in warming himself by means of combustibles furnished either by the existing vegetation, or by the remains of the ancient vegetation of the globe, and in nourishing himself by means of products obtained from plants and animals, demands everything from life; but could he dispense with life in obtaining his combustible and his nutriment? Would the forces of science alone suffice to assure to him, in this urgent need, those satisfactions which he could no longer demand from the forces of living nature?

This was the question. If put in a time of peace and in the midst of abundance, it would probably have received more than one response in the affirmative. The progress of the physical sciences has been so brilliant! One is so much disposed to exaggerate their power! Electricity opens up such seductive perspectives! Synthesis has produced so many marvels in the hands of chemists!

If the necessity had not been so pressing, so that the question might have been raised as a philosophical thesis, and we could have said to the physicists and chemists, could you not, if it were necessary, furnish man with heat and food without having recourse to plants and animals? how many, without saying *yes*, would at least have answered with one of those smiles which do not say *no*.

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But in a crisis where it was necessary to realise immediately what would have been left to hope, people showed reserve; radical solutions were adjourned, and there was no question either of heating Paris without combustibles, or of feeding it without organic aliments.

But could organic materials usually disdained be converted into aliments, so as to replace, by means of clever combinations, those natural products which could no longer be procured?

It is not my design to notice what viands were served at table, or what resources we were led to seek in the blood and offal of the slaughter-houses which are usually thrown away, the bones, feet, and even the skins of the cattle slaughtered. Nor will I examine how the butter and lard, which were speedily exhausted, were replaced. Of these improvised arts some have disappeared with the circumstances which gave them birth, whilst others have left some useful teachings.

I shall treat only of a special question, the solution of which involved certain principles which it seems to me to be important to guard. Was it not possible to come to the assistance of new-born children by replacing the milk, which could no longer be got, by some saccharine emulsion? In this case there was no question of creative chemistry, but only of culinary chemistry. Recipes were not wanting, all reproducing an albuminous liquid, sugar, and an emulsion of a fatty body.

As a provisional succedaneum this artificial milk deserved to be welcomed. But sometimes there was such a conviction in the authors of these propositions, that one was forced to dread for the future the effects of their faith. This was of a nature to make too many proselytes, to the great injury of the children at nurse, and the great profit of the dealers in milk. How could the latter have the least scruple when they were taught to manufacture an emulsion which they saw recommended to the consumers, and even to mothers, as the real equivalent of milk?

The services rendered by concentrated milk during the siege were too important to render any excuse necessary in the country which produces it, when we insist upon the preference always due to natural milk, as also upon the characters which at present do not permit us to confound any artificial milky liquid whatever with the truly secreted product.

Natural milk forms a liquid containing salts, sugar, casein in solution, and fatty globules in suspension. Let us first see whether we can imitate these fatty globules by dividing or making an emulsion of an oily or fatty matter in a viscous liquid.

I believe that I experimentally demonstrated the contrary some years ago, by showing that the globules of fatty matter of milk are protected from certain physical or chemical reactions by a true membranous envelope. Admitted by some, and disputed by others, the existence of this membrane seeming to me to be real and proven, there could be no question, in my opinion, about confounding an artificial emulsion with naked fatty globules with milk from the mammæ, presenting fatty globules enveloped by a membrane, true free cells, filled with butter, analogous to the agglutinated cells of adipose tissues.

The existence of this membrane may be proved by two chemical experiments.

The first depends upon the property possessed by sulphuric ether of dissolving fatty matters and collecting together those which are suspended in liquids, provided that they are free. Now if, after shaking together in a tube fresh milk and ether, they are left to rest, the ether floats on the surface without having dissolved anything, and the milk resumes its place below the ether without having lost anything of its appearance, or yielded any of its buttery matter.

But when subjected beforehand to the action of acetic acid, which is able to dissolve the envelopes of its fatty globules, milk, when shaken up with ether, loses its opacity, and yields its butter to that liquid, in which it may be found.

An inverse test leads to the same conclusions. A neutral salt, such as sulphate of soda, added to milk, enables us to filter it, and to retain upon the filter the globules of butter, whilst the serosity flows off perfectly limpid and clear. If the washings with saline water be continued, these globules may be freed from all the soluble products of the serum. Now if the butter consisted of simple fatty globules, there would then remain with them no trace of albuminous or caseous matter. But whatever care may be taken to prolong the washings, we always find with the fatty matter such a proportion of albumenised substance that there can be no doubt that it has remained there in the form of those envelopes or cells which constitute the globules of butter.

The microscope, moreover, shows plainly the constitution of the globules of butter, and reveals the constant presence of the envelopes. It is sufficient to crush the globules of milk by means of the compressor, to obtain a conviction that, after the spreading of the fatty matter, the butter-cell still retains its form and outline, thus showing that the contents and the container have each their distinct existence.

For these reasons, and for many others (for no conscientious chemist can assert that the analysis of milk has made known all the products necessary to life which that aliment contains), we must renounce, for the present, the pretension to make milk, and especially abstain from assimilating any emulsions to this product.

Besides we cannot have too much reserve where we have to pronounce upon the identity of two products, one natural, the other artificial, if they are not crystallisable or volatile—that is to say, definite. We can never affirm that we have reproduced a mineral water, or sea-water for example. When manure for plants, or aliments for man and animals are in question, is not the same reserve still more imperative?

These indefinite natural mixtures contain substances which the coarsest analysis discovers, with others less strongly characterised or less abundant, which are only revealed by delicate chemistry, and others again, and perhaps the most essential, which still escape us, either because they exist in infinitesimal proportions, or because they belong to the category of bodies which have not hitherto been distinguished from other chemical species.

It is therefore always prudent to abstain from pronouncing upon the identity of these indefinite mixtures employed in the sustenance of life, in which the smallest and most insignificant traces of matters may prove to be not only efficacious, but even indispensable. In proportion as science extends her domain, we are sure to see the demonstrations of the appropriateness of this reserve multiplied.

Among the fine investigations executed in France by those who have continued the labours which occupied the life of the illustrious Théodore de Saussure, the important thesis of M. Raulin upon the vegetation of *Aspergillus niger* will always be placed in the foremost rank. All the conditions of the life of this Mucedinean have been so well determined by that author that it may be cultivated with precision in a soil formed of definite chemical species, as if we had to do with the formation of a compound; and the soil once sown, we may follow the transformation or the employment of each of the elements necessary to its life, just as if we had to do with the development of an ordinary chemical equation.

Now, who could have foreseen that the *Aspergillus niger*, which has just made its appearance, for example, upon a slice of lemon, exposed to the air, required for the fulness of its existence traces of *oxide of zinc*? How, after this, can we doubt, in the case of plants of a higher order and especially of animals, that, besides their coarsely appreciable aliments, they require also traces of many other aliments, more delicately used but not less necessary?

Milk has often been compared to eggs, both from a chemical and a physiological point of view. Their mission is equally to furnish the young animal wit

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nourishment of its earliest age; and they have as a common character that they present in union a fatty matter, an albumenoid substance, a saccharine or amylaceous matter, and salts.

But the egg possesses a vitality, an organisation, of which chemistry furnishes no evidence, and which the most minute anatomy would be powerless to reveal. If fecundation had not rendered manifest, by the rapid phenomena of segmentation which take place in it, that the mass of the yolk of an egg is endowed with life, and that it obeys the impulsion of the living germ which takes possession of it, we should still be ignorant that the yolk of the egg is not a mere emulsion of inert fatty matter.

Is not milk in the same case? One is led to think so when we see that the yolk of the egg and milk have the same destination and the same configuration, and that, if the yolk obeys the action of the germ which is nourished by it, milk, for its part, proves to be singularly ready to receive and nourish germs of more than one kind, which, on reaching it, become developed and live at its expense.

The power of synthesis of organic chemistry in particular, and that of chemistry in general, have therefore their limits. The siege of Paris will have proved that we have no pretension to make bread or meat from their elements, and that we must still leave to nature the mission of producing milk. If some illusions upon this point have found their way into the minds of persons ill-informed as to the true state of science, they are due to the dangerous play of words to which the expressions *organic chemistry* and *organic substances* lend themselves, when applied, as these are, indifferently, to definite compounds, such as alcohol or citric acid, which are unfitted for life, and to indefinite tissues, the seat of life.

The former (foreign to life, and true chemical species) are the only ones that synthesis has reproduced. The latter, which can be formed only under the impulse of a living germ, and which receive, preserve, and transfer the forces of life, are not definite species; the synthesis of the laboratories does not reach them. The only synthesis which has hitherto been observed in the case of the chemical materials which constitute living tissues, is that determined in brute matter by the presence and impulse of the living germ itself.

All those chemical syntheses, otherwise so worthy of interest, which have been indicated as reproducing organic matters, have therefore in reality reproduced only matters, unfitted for life—that is to say, mineral matters. Thus of every living matter or matter that has lived, we must still, whether we speak as chemists or physiologists, say what was said of it formerly: *omne vivum ex ovo*—that which is not life has brought nothing to life.

With regard to the constitution of milk, the phenomena presented by the clarifying of butter have been sometimes employed either to demonstrate or to dispute the existence of the membranes which envelope the butyrous globules; I cannot at present regard these phenomena as having any value in this respect.

It has been said, for example, that the separation of butter was the result of the formation of lactic acid arising from the action of the air, favoured by churning. Numerous experiments effected in my laboratory upon a practical scale have shown that butter separates equally promptly, and at least equally abundantly, from a milk to which a large amount of bicarbonate of soda has been added, as from natural milk. The alkaline reaction of the former, which is maintained during the operation and after its completion, has no influence either upon its duration or its result. The proportion of butter, far from being diminished, seems even to have been increased by it.

The formation of lactic acid is therefore not necessary for the separation of butter, which appears to me to be due to purely mechanical causes. Such, at least, is the feeling that one experiences on examining by the microscope milk submitted to churning whilst the operation is going on. The first test-drops present nothing peculiar; the globules of butter retain their form, dimensions, and aspect. Soon we see appear irregular butyrous islands in the midst of globules remaining unaltered. These islands of butter increase in number and extent in proportion as the operation proceeds. They form a snowball, uniting witheach other and becoming agglomerated, so as to constitute at last the mass of butter which is the object of the operation.

The agglomeration of the butyrous globules into a block of butter would be a true regelation if there were no membrane surrounding them. The existence of this compels us to admit that it must be broken, and that this is the object of the repeated shocks which we make the liquid undergo, in order that the diffused butter may unite with the fatty parcels and agglomerations which it meets with on its road.

If it is true that the separation of butter is a purely mechanical phenomenon, it is not the less so, as I shall hereafter show, because chemistry can give rules to render this operation more rapid and more efficacious, and to produce from it a better clarified and less alterable butter.

I conclude this communication with some details upon phenomena of another nature, towards which the hygienic situation of the inhabitants of besieged Paris turned one's thoughts only too naturally. What took place in the tissues of this population deprived of fresh vegetables, fruits, milk, fish, and fresh meat? What changes did the blood undergo under the influence of this diet? and how must they manifest themselves?

Some years ago I had prepared some experiments, the object of which was to ascertain whether exchanges by exosmose and endosmose take place between the internal liquids contained in the globules of the blood and the liquids of the serum. If these exchanges were easy and rapid, their existence might be ascertained. To demonstrate them would be to ascertain by what means the constitution of the globules of the blood may be altered and vitiated, re-established, or regenerated.

I never completed these experiments; but I have often depended upon the views which guided me, in order to make the auditors in my courses at the Faculty of Medicine understand how certain alterations of the blood might be interpreted.

It is necessary, perhaps, to explain what stopped me.

Nothing is easier than to compare the serum and globules of a normal blood with the serum and globules of the same blood, modified by the intervention of a substance capable of changing the direction or the intensity of the powers of endosmose between the globules and the serum.

In the blood of a living animal the globules suspended in the liquid may absorb or lose some of their elements, if we succeed in changing the constitution of the serum; but how long will the phenomenon last? If the substance added be mischievous it will be eliminated; the veins on their part will absorb liquids destined to re-establish the equilibrium, and the experiment will soon be so altered that the little differences that we have to measure will disappear, vanishing before great complications.

On the contrary, if we withdraw the blood from the body of the animal and divide it into two parts of equal weight, one destined to furnish the term of comparison, and the other to receive the substances modificative of the power of endosmose, coagulation and what I have called the asphyxia and death of the globules will soon do away with any hope of arriving at certain results.

It was therefore necessary to receive the blood into a vessel, to oppose its coagulation, and to replace towards it the action both of the heart and lungs—that is to say, to keep the blood in movement and to present it in a very divided state to the action of oxygen or of the air. I arranged an apparatus which fulfilled these conditions, and allowed one to ascertain how alcohol, neutral salts of soda or potash, sugar &c., act when added to the serum, and how the interior liquids contained in the globules may become modified under their influence either in quantity or in nature.

While I followed out these views, preoccupied by the

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evident invasion of scurvy in the general state of health of the inhabitants of Paris towards the close of the siege, and whilst I sought to make up by applicable means for the absence of all fresh vegetables and of all fruit in their habitual diet, a foreign doctor, Dr. J. Sinclair, by following out the ideas which he had heard me teach upon this subject, was led to seek in them the explanation of the first symptons of alcoholisms, a state which he designates by the name of dypsomania.

Just as scurvy would have as its primary cause an impoverishment of the serum in potash-salts and a surcharge of salts of soda (which favours the exosmose of the potash of the globules and consequently their destruction), so alcoholism would have as its starting-point the presence of alcohol in the serum of the blood and its effects on the globules.

Alcohol added to the serum causes a movement of exosmose from the interior of the globules to the serum. The globules lose a part of their constituent liquids; and this alteration, which brings on others, is no doubt reproduced in the cells of the various tissues which are bathed by alcoholised liquids.

What it is now my intention to prove is, that in the blood in particular, and in every living organism of analogous constitution (that is to say, formed by cells or utricles filled with a liquid and floating in or bathed by a liquid), it is sufficient to alter, even slightly, the chemical composition of the exterior liquid to cause that of the interior liquid to become modified by endosmose or exosmose.

I propose to follow out the development and application of this principle, either to demonstrate the effects produced by the action of common salt, alcohol, &c., upon the blood, or to show how rapid is that of some agents, of which I have already examined the action, upon the constitution of the globules.

STEAM-BOILER WATERS AND INCRUSTATIONS.*

By Dr. JOSEPH G. ROGERS, of Madison, Ind.

ALL natural waters contain more or less mineral matter. This is acquired by contact with the earth's surface, and by percolation through its soil and rocks. It consists principally of carbonates of lime and magnesia, sulphate of lime, and chloride of sodium, in solution, and clay, sand, and vegetable matter, in suspension. The many other saline ingredients found in various waters exist in very small proportions, are generally very soluble, and therefore have no relation to the utility of waters in boilers. Of the above-mentioned salts, the carbonates of lime and magnesia are only soluble when the water contains free carbonic acid—consequently the waters of rivers, lakes, &c., contain them in less quantities than those of wells, springs, and creeks, owing to the precipitation caused by the spontaneous evolution of the solvent on exposure to air, heat, and light. Our American rivers contain from 2 to 6 grains of saline matter in the gallon, in solution, and a varying quantity in suspension, generally exceeding 10 grains. Well and spring waters hold but little in suspension but a quantity of the dissolved salts, varying from 10 to 650 grains in the gallon. When such water is boiled the carbonic acid is driven off, and the carbonates, deprived of their solvent, are rapidly precipitated in a finely crystallised form, tenaciously adherent to whatever they may first fall upon. Sulphate of lime requires 500 parts of water for its solution, and as the water evaporates supersaturation occurs, and the salt is precipitated in the same form and with the same adherent quality as the carbonates. Chloride of sodium and all the other more soluble salts are precipitated by the same process of supersaturation, but, owing to their greater solubility, much more evaporation is required. All suspended matter gradually tends to subside. This combined deposit, of which the carbonate of lime usually forms the greater part, remains adherent to the inner surface of the boiler, undisturbed by the force of the boiling currents. Gradually accumulating, it becomes harder and thicker, till it is as dense as porcelain, though tougher, and at length may obtain such a thickness as to prevent the proper heating of the water by any fire that can be placed in the furnace. The high heats, sometimes necessary to heat water through thick scale, will sometimes convert the scale into absolute glass by combining the sand with the alkaline salts composing it. The evil effects of the scale are due to the fact that it is relatively a non-conductor of heat. Its conducting power compared with that of iron is as 1 to 37·5. Consequently more fuel is required to heat water in an incrusted boiler than in the same boiler if clean. A scale $\frac{1}{16}$th inch thick will require the extra expenditure of 15 per cent more fuel. This ratio increases as the scale is thicker. Thus when it is $\frac{1}{4}$ inch, 60 per cent more fuel is needed; $\frac{1}{2}$ inch, 150 per cent, &c. Abstractly then, to raise water in a boiler to any given heat, the fire-surface of that boiler must be heated to a temperature according with the thickness of the incrustation in an increasing ratio. To illustrate—to raise steam to a pressure of 90 lbs., the water must be heated to about 320° F. In a clean boiler of $\frac{1}{4}$ inch iron this may be done by heating the external surface of the shell to about 325°. If $\frac{1}{4}$ an inch of scale intervenes between the shell and the water, such is its non-conduction that it will be necessary to heat the fire-surface to about 700°, almost low red-heat. Now the higher the temperature at which iron is kept, the more rapidly it oxidises, and at any heat above 600° it very soon becomes granular and brittle, and is liable to bulge, crack, or otherwise give way to the internal pressure. This condition predisposes the boiler to explosions, and makes necessary expensive repairs. Again, it is readily seen that the presence of scale renders slower and more difficult the raising, maintaining, and lowering of steam.

To obviate the evils arising from incrustation, many methods have been devised to prevent and remove it. For this purpose picking, scraping, cleaning, &c., are very generally resorted to. Such is its toughness and tenacity, however, that this only partially succeeds, and is moreover expensive in time and money, since it is generally necessary to lose a working day in the operation. Various mechanical contrivances have been introduced, intended to intercept the precipitated saline matter from the supply water on its passage through the heating apparatus. They consist essentially of a series of obstructions to the flow of the water. After it has been heated almost to boiling by the exhaust steam, the carbonates are precipitated, and subside upon the shelves, straw, and other obstructions, over which the water flows. This plan, however, only partially fulfils the purpose, since it only intercepts a portion of the carbonates and suspended matter. The soluble salts all pass on into the boiler, and a great portion of the dissolved carbonates also, which cannot be precipitated during the short passage through the heater. The scales form more slowly, but as surely. It is impossible to make such contrivances completely efficacious. No mechanical arrangement will suffice. To chemistry alone must we look for the desired means. For a long time simple chemical means have been used in an empirical way with some success. The *modus operandi* of some of these I will notice. Starchy matters—such as Indian corn, potatoes, oil-cake, &c.—prevent scale only by enveloping the precipitates with gelatinous matter, thus lessening their weight, causing them to float, and obviating their agglutination into solid masses. This application, however, tends to cause foaming or frothing of the water, making it impossible to determine the quantity in the boiler, and hence is objectionable.

* Abstract of a paper read before the American Association for the Advancement of Science at Indianapolis, 1871.

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Molasses, fruits, cider, slops, vinegar, cane-juice, and a variety of other things, containing more or less acetic acid, placed in the boiler, convert the carbonates into soluble acetates. The sulphate of lime remains unaltered, however, and the iron being as much open to the attacks of the acid as the saline matter, the boiler is slowly, but surely, damaged.

Oak, hemlock, and other barks and woods operate by means of the tannic acid therein. Various extracts, such as catechu, logwood, &c., very rich in tannin, are also used. Tannic acid decomposes the carbonates, but, unlike the acetates, the resulting tannates are insoluble. Their specific gravity, however, is low; they float in the currents of ebullition, and, having no tendency to adhere, do not agglutinate into a mass, and cannot form a scale. The sulphates and chlorides are not acted upon at all by the tannic acid, and will incrustate notwithstanding its presence. Tannin, as offered in the above-named agents, is left free to act upon the iron, and will, after a time, exhibit its damaging effects on the boiler.

The fixed alkalies are much used for this purpose, in the various forms of lye, ashes, carbonate of soda, caustic soda, potash, &c. These agents decompose the sulphate of lime, sulphate of soda or potash and carbonate of lime being the results. The first is held in solution, the latter is precipitated, but in larger crystals, which do not form so refractory a scale as ordinarily. The carbonates of lime and magnesia are also precipitated by these agents, the free carbonic acid being taken to form carbonates or bicarbonates of soda or potash; the chlorides are not affected. This method simply modifies the form of the precipitate, and consequently the quality of the scale, without affording any means for its prevention, and therefore deserves but little attention. Ammonia and its carbonate have a precisely similar action, and the same objection stands against them. These alkalies have no chemical action on the boiler, but rather tend to preserve it, inasmuch as they prevent the free carbonic acid from combining with the insoluble crust of oxide of iron (formed by contact with the water) to form a soluble carbonate of iron, which, being dissolved away from the iron, would leave a surface constantly exposed to fresh action. Chloride of ammonium is another means employed. This has its action only on the carbonates of lime and magnesia. The reaction produces carbonate of ammonia, which, being volatile, passes off with the steam, and chlorides of calcium and magnesium, both very soluble. This is an efficient way of removing old scale. Its only objection is the ammoniacal odour of the escaped steam.

The foregoing are methods in which a single agent is used. They are frequently combined with a view of obviating the mentioned objections. Starch, tannin, and soda constitute the basis of most of these combinations. Crude petroleum is also used with reported partial success. The *rationale* of its action is not well understood, owing to the complexity of its chemical constitution. There are many proprietary compounds at present in use composed essentially of these elements, generally, however, with the addition of other things, introduced for the purpose of disguising their composition. Besides these, many other preparations are before the public which have been patented, all having a general resemblance, inasmuch as tannin, starch, and soda are the principal ingredients, in some form. Gum catechu is most generally the tannin-bearing body; sal soda, the alkali; and flax-seed, oil-seed cake, bran, or coarse flour the starchy element. In most of those which I have examined these very useful agents have been simply mixed empirically, without regard to chemical laws, and they generally contain more or less free tannic acid, and a considerable amount of inert, insoluble vegetable matter, which tends to produce foaming, besides being useless. Besides these methods, in which the chemical agents are introduced directly into the boiler, others have been devised, in which the waters are depurated, by chemical means, before entrance into the boiler. Clark's process consists in the precipitation of the carbonates with milk of lime, the free carbonic acid being taken up; the sulphate of lime remains in solution. Another method, proposed by myself, consists in converting the earthy carbonates into soluble chlorides by hydrochloric acid, and neutralising the excess of acid by filtration through carbonate of baryta (witherite) in coarse powder. The soluble chloride of barium thus formed decomposes the sulphate of lime, chloride of calcium being kept in solution, and the sulphate of baryta being deposited insoluble. This method recommends itself for railway water stations, on account of its cheapness and simplicity.

Oxalic acid may be used very efficiently for the complete precipitation of all the lime salts as insoluble oxalates, but the expense might be a bar to its use. Tannic and acetic acids, the excess being properly neutralised by carbonate of soda, may also be used for tank depuration.

These tank methods, however, cannot influence to any great extent the scale already formed; and as the removal of this is as needful as its prevention, it is palpable that that method is best for general application which attains the complete removal, as well as prevention, by chemical means operating inside the boiler.

Having this end in view, the writer has proposed two processes: one consists simply in the introduction into the boiler of a sufficient quantity of the oxalate of soda to cause the immediate decomposition of the scale-forming salts as they enter the boiler, converting them into insoluble oxalates, which are precipitated as a mushy sediment, which has no tendency to form scale, and which may be blown out from the mud-receiver, or otherwise voided. In the other process tannate of soda is the agent, kept constantly present in the boiler in solution; it decomposes the carbonates of lime and magnesia as they enter, tannates being precipitated in a light, flocculent, amorphous form, so that they do not subside at all in the boiler, but are retained in suspension by the boiling currents until they find their way into the same receiver, when they settle into a loose, mushy mass, which may be easily blown out from time to time. The carbonate of soda formed in the reaction is retained in solution, becoming a bicarbonate by appropriation of the free carbonic acid in the water. This decomposes the sulphate of lime, the resulting sulphate of soda being retained in solution, and the carbonate of lime being acted upon by fresh portions of the tannate of soda as above. The constant presence of the alkali protects the iron from all action, either of the carbonic or tannic acids. The same reactions take place between the tannate of soda and the already existing scale with like results, but more slowly, some weeks being generally required, in practice, in removing the deposit, if it exists in any considerable quantity.

Portions of scale are detached, from time to time, which may be removed at the usual cleanings, which should be made at short intervals, when possible, until the boiler is entirely clear of all incrustation, after which this will not be necessary. Extensive practical trial of this process for two years has demonstrated its utility for all varieties of boilers. It is economical, easy of application, and generally adaptable. It may be used in marine boilers as well as those using fresh water, since the marine scale is almost identical with that formed in boilers using ordinary waters, consisting almost entirely of the carbonates of lime and magnesia and sulphate of lime. The chloride of sodium forms a mushy deposit, but is only incorporated in the scale to a slight extent.

University of London.—The following is a list of the candidates who have passed the recent D.Sc. Examination:—*Branch* VI. Electricity.—Alexander Muirhead, University College. *Branch* IX. Animal Physiology.—Henry Newell Martin, M.B., Christ's Cambr. and University.

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ON A RELATION BETWEEN THE CHEMICAL GROUPING OF CERTAIN ELEMENTS, AND THE QUANTITIES IN WHICH THEY EXIST UPON THE EARTH'S SURFACE.

By JOHN A. R. NEWLANDS, F.C.S.

If a list be made of the fourteen principal elements which occur on the earth's surface (including the ocean and the atmosphere) in the largest quantities, which are also most widely distributed, and which appear essential to vegetable or animal life, it will be observed that they comprise two representatives of each of the chief chemical groups. Thus we have—

1. Hydrogen and chlorine.
2. Sodium and potassium.
3. Magnesium and calcium.
4. Aluminium and iron.
5. Carbon and silicon.
6. Nitrogen and phosphorus.
7. Oxygen and sulphur.

Hydrogen and chlorine are here classed together on account of their mutual replaceability, with but slight change of properties, in many chemical compounds, such as trichloracetic acid, &c. The position, too, of hydrogen in the list of elements, when arranged in the order of atomic weights, indicates that it is really the lowest member of the chlorine group.

ON DYES AND DYE-STUFFS OTHER THAN ANILINE.*

By Dr. F. CRACE CALVERT, F.R.S.

(Continued from p. 10).

I SHALL now call your attention to a very remarkable discovery, recently made by the late Professor Bolley, viz., the conversion of purpurine into alizarine. If purpurine is heated in the atmosphere, as stated above, it is nearly all sublimed, leaving only a small amount of carbonaceous residue, but if heated in sealed tubes, at a temperature of 400°, it forms a carbonaceous mass, from which water extracts alizarine. Under the influence of the high temperature, the purpurine loses an equivalent of oxygen, and is converted into alizarine. This reaction appears to confirm the opinion of M. Decaisne, that the madder plant contains only one colour-giving principle, which under the oxidising influence of the atmosphere becomes converted, first, into alizarine, then purpurine, and afterwards into the still more highly oxidised compounds.

The difficulty and expense experienced by calico-printers in brightening their colours, and obtaining pure whites in madder-dyed goods, attracted many years ago the attention of scientific and practical men, and any process by which these difficulties might be overcome was anxiously looked for. The discovery of MM. Robiquet and Collins, that the colour-giving principle was not destroyed by sulphuric acid, was the step in that direction, and led M. E. Schwartz to observe that the carbonaceous mass of Robiquet, if carefully washed and neutralised, could be used as a dye-stuff. MM. Lagier and Thomas improved upon this, and introduced, in 1839, an article which is now extensively used by calico-printers and named garancine, and now is prepared as follows:—Madder, either unwashed, or, better still, washed with cold water, is mixed with one-third of its weight of sulphuric acid which has been previously diluted with water till it marks 10° Twaddle; it is then boiled for four or five hours, and the mixture run on to woollen filters, and washed till only a mere trace of acid remains. It is then either removed or washed once with a very weak solution of carbonate of soda, submitted to hydraulic pressure, and then introduced into drying stoves. One hundred parts of madder yield from 34 to 37 of garancine. Garancine is a fine powder, of a light brown colour, and has a dyeing power four times as great as the original madder. It does not give as good blacks as madder, nor are its purple, red, and pink so fast, but its purple is brighter, and the whites are obtained pure without soaping, it being only necessary to substitute a slight clearing liquor, composed of an alkaline hypochlorite of soda, to which is added a small portion of sulphate of zinc.

In 1852, Messrs. Pinckoff and Schunck effected an improvement in the manufacture of garancine, their product being known in England under the name of commercial alizarine; but on the Continent it is better known as *Pincoffine*. Their process consists in submitting ordinary garancine to the action of high pressure steam of a temperature of 300° F., which, whilst it does not act on the alizarine contained in the garancine, destroys two other colouring matters which are present. These Dr. Schunck has isolated and examined, and named *Rubertine* and *Rerantine*. They are of a peculiar resinous nature, and spoil both the whites and the purples, which are fixed along with alizarine in the dyeing process. The employment of commereial alizarine is especially advantageous in the production of purples, which are faster and more brilliant than those produced by ordinary garancine. The cloth also does not require either soaping or cleansing.

M. Pernod, has, within the last two or three years, introduced a madder extract, which is at the present time extensively used in Lancashire as a topical colour. This term is applied to a colour which is printed on a fabric, and afterwards fixed by steaming. By this method bright and fast colours are introduced in printed goods, producing much more effective designs than could be effected if the goods had to pass through a dye-beck and afterwards be washed with large quantities of water. Some splendid specimens of this class of printing were to be seen at the Universal Exhibition, 1867.

To prepare the extract, garancine is lixiviated till completely exhausted, with a nearly boiling solution of sulphuric acid, containing five parts of acid to a thousand of water. On cooling, an orange-red precipitate falls to the bottom of the vessel, which, when collected and thoroughly washed, constitutes an extract ready for use. The products of M. Leitenberger and Messrs. Schaaffer and Lauth may be substituted for this extract.

As the employment of these extracts is the most important improvement recently introduced into calico printing, I will give the three following recipes for their application:—To produce dark red, take 8 lbs. of extract of madder, 4 lbs. acetic acid, and 1¼ lbs. starch. Boil these in an earthenware vessel, and when cold add to six measures of the above one of acetate of alumina and a very small quantity of Gallipoli oil, say one per cent. For a pale red, take 4 lbs. of extract of madder, 2 lbs. of acetic acid, 10 quarts of gum Senegal water, and 1 pint of acetate of alumina. To obtain a purple, take 1 pint of extract of madder, half pint of acetic acid, half pint of water, and 3 ozs. starch; boil, and when the mixture is cool, 5 ozs. measure of acetate iron of 24° Twaddle, and 5 ozs. of water. To produce a chocolate, proceed as in the last recipe, substituting acetate of chrome for the acetate of iron.

The above mixtures are printed on cloth by means of engraved copper rollers, and are then dried and submitted to dry high-pressure steam for one or two hours, when the colours have become fixed on the fabric. After being slightly soaped, to remove all excess of colour, the prints are stiffened, and ready for the market.

Although I have now concluded my lecture on madder as a dye-stuff, and have already exceeded the time allotted

* The Cantor Lectures, delivered before the Society of Arts. Revised and communicated by the Author.

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to me, I hope you will allow me a few minutes more, to enable me to give an outline of the processes by which madder styles are produced, the more so as there may be some persons present who are not aware how madder and garancine prints, now manufactured in such enormous quantities and in such general use, are produced.

To effect this, the ordinary white calico, as sold in shops, is not sufficiently deprived of its impurities to be employed in madder or garancine styles; it has therefore to undergo further bleaching operations. The calico so extra bleached is then printed by means of copper rollers, on which the pattern to be produced is engraved. This roller leaves on the calico a red, purple, or chocolate mordant; that is for red, a sulpho-acetate of alumina, or red mordant; for purples, violets, and blacks, an impure acetate of protoxide of iron, known in the trade as pyrolignite of iron, or black liquor; and for chocolates a mixture of these two mordants.

After this operation the pieces undergo a process technically termed ageing. This was formerly effected by spreading out the pieces, and hanging them in a room for three or four days, so that the acetate of alumina might lose part of its acetic acid, and the iron mordant nearly the whole of it, thus liberating the oxide of iron and enabling it to undergo partial oxidation.

Some few years ago, Mr. David Thom introduced a process by which this is effected in twenty minutes; it consists in passing the printed mordanted cloth over rollers fixed in a machine placed in a chamber about twenty feet long, in which a current of air and steam is thrown. The temperature of this chamber must not be below 100° nor above 108°, and the quantity of steam present must be such that 50 yards of calico will take up one ounce of moisture during the twenty minutes it takes to pass through the chamber. The printer is able to test the state of the chamber by means of wet and dry bulb thermometers. The next operation to which the cloth is submitted is dunging. The process received this name because formerly the calico was passed through a mixture of cow-dung with water. Now, however, silicates or arseniates of soda, mixed with a little chlorate of potash, are substituted. After passing through either of these solutions they are washed, and ready to be passed through the dye-beck. This beck contains water, and from five to seven pounds of madder, or one to two and a half pounds of garancine, or commercial alizarine, for each piece of calico to be dyed. The heat of the bath is then gradually raised, by means of a jet of steam, to 180° for garancines, or 212° for madders. This operation takes from one and a-half to two hours, according to class of goods, style, &c. The fabrics are then washed and passed through a cleansing liquor for garancine or commercial alizarine styles, or soaped twice at 180, when they are dyed with madder.

The most permanent and brilliant colour produced from the *Rubia* plant on cotton fabrics is Turkey red. The details so essential to success in dyeing this colour are kept by each dyer a secret, but I will attempt, as briefly as possible, to give the main features of the process. After the bleaching of the fabric is completed, they are passed through Gallipoli oil, and then exposed to the atmosphere in heated chambers. This operation is repeated several times. The next one consists in passing the cloth through a weak alkaline solution. After this they go through a solution of acetate of alumina, and then through a bath of a tannin substance. By these processes, no doubt, the fatty acids of the oil combine with the alumina, as does the tannic acid of the tannin matter, helping to fix the mordant in the fibre of the fabric. On being dyed, the goods assume a rich, dark red tone, to which briliancy is imparted by passing the dye fabric through heated soap solutions.

I should occupy too much of your time were I to attempt to enter into the details of the methods by which chemists determine the relative tinctorials powers of roots, madders, and garancines, but I may give you a very simple method of detecting ordinary adulterations of garancine by dye woods and tanning matters. Pieces of blotting paper are dipped into a weak solution of chloride of tin and sulphate of protoxide of iron, and on each of these sheets is sprinkled a little of the suspected garancine. If a dye wood be present, the chloride of tin paper will assume a red colour, and if tannin matter be present, the iron paper will be blackened.

(To be continued).

NOTICES OF BOOKS.

Notices on Nuisances, Drains, and Dwellings. By W. H. Penning, F.G.S. London: Baillière and Co.

Mr. Penning tells us that his pamphlet was written during a period of incapacity for his usual avocations, and most sincerely do we wish that such periods could be so usefully employed. The author deals with sewer-gas, the escape of ordinary gas, decaying organic matter, damp, and smoke as nuisances, giving subsequent chapters on ventilation, air-shafts, and the general prevention of nuisances. The remarks show much common sense, and are easily applicable.

Notes of Fifteen Lectures on "Physics and Chemistry." Delivered by Professor Guthrie, in the Lecture Theatre of the South Kensington Museum during January and February, 1872.

These are the notes of lectures delivered in the course of instruction in Science and Art for Women by Professor Guthrie. Quietly pursuing course after course of lectures, Dr. Guthrie has done and does more for the advancement of science than many whose names are daily before the public. In these notes we have the sum of this department of Professor Guthrie's work. To the lecturer, the teacher, and the student of chemistry and physics the notes will be most valuable; to the lecturer and teacher they will afford a basis of discourse; to the student they will prove an admirable means of self-examination. In the recapitulation or "Gossip" on his lectures, Professor Guthrie speaks with the greatest point. Says he—"The heavenly bodies in their orbits are types of the particles of matter which we handle. Call these small parts particles if you please, or call them molecules, but do not call them atoms: do not write '*finis*' to the book of nature." Most sincerely is Professor Guthrie to be congratulated on the successful issue of his work at South Kensington.

Index to Gmelin's Handbook of Chemistry. By Henry Watts, B.A., F.R.S., F.C.S., Editor of the "Journal of the Chemical Society." London: Harrison. 1872.

Every chemist will rejoice to learn that the Index to "Gmelin" is published. We need not dwell upon the advantages of the possession of a complete series of this admirable and exact work, for the volumes are generally regarded as indispensable to the shelves of the chemist. So great is the demand that several of the volumes are out of print, and others are very scarce. It being probable that now the Index is published there will be a call upon the later volumes of the work, we recommend our readers to order their copies at once to prevent disappointment. The concluding volume (the 18th) and the Index, are included in the subscription to the Cavendish Society for the year 1864. It need not be said that the arrangement of the Index is thoroughly logical, every compound being taken under as many heads as possible to facilitate reference. The employment of Arabic numerals, but in different types, in referring to both volume and page, is much to be commended as preventing confusion. In a word, the announcement that the work is complete, will be deemed in our pages a sufficient notice.

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CORRESPONDENCE.

PROPOSED ASSOCIATION OF MANUFACTURING CHEMISTS.

To the Editor of the Chemical News.

Sir,—As manager of one of the largest chemical works in Lancashire, may I express the great gratification with which I have read the two able letters of your correspondents, and your own clear and cogent exhibit of reasons in favour of an association of manufacturing chemists. To illustrate how one manufacturer may communicate valuable information to another without being any the poorer for it, perhaps you will allow me space for the following brief statement of fact:—There is an extensive chemical manufacturer in this district, who has just re-leaded, and divided into smaller ones, two immense vitriol chambers: the legacy to him of a time when everybody built them of enormous size. As each of these large chambers represented one-third of his entire chamber capacity, the simple result was that, by the dislocation, his manufacturing power was reduced one-third, while, at a ruinous cost, he had to buy vitriol to make up the deficiency during the whole time of the repairs. Of course the stoppage and repair of a chamber one-fourth the size of these would only have reduced his producing calibre one-twelfth—a mere bagatelle. One would think that considerations like this would be patent to the merest tyro in scientific manufacturing; but they are not, for—influenced solely by the relatively paltry object of saving lead—owners of works are still to be found putting up chambers of very large size. I conclude by remarking that if any intending vitriol maker is guided in his erections by what I have said, he may save many hundreds of pounds by what has cost me only

Pen and Ink.

To the Editor of the Chemical News.

Sir,—It may seem strange for an engineer to express an opinion upon the proposal for an association of manufacturing chemists, but I have long had an opinion that such an association would benefit all concerned. I only hope that should such a society be formed, membership will not be limited to the profession strictly.

One can hardly exaggerate in statements as to the difficulty of obtaining reliable information on chemical matters, more especially as to the quantity of work performed in plants of certain size and the cost of the said work. In answer to enquiries and questions, I have had replies so widely different from divers persons that I am obliged to suppose some of them have been concocted for the express purpose of misleading.

Of course no society can exist successfully unless the members from the outset studiously avoid all attempts at concealment or misleading; and, on the contrary, endeavour to exchange ideas as much as possible.—I am, &c.,

Thos. Wilkins.

Adelaide Chambers, 52, Gracechurch Street,
July 6, 1872.

PS.—Re Coffey's stills for ammonia. About four or five years ago Messrs. Packard, of Ipswich, erected one at their Bramford works; it was working one or two years to my knowledge, and may still be so.

The description in Muspratt is hardly correct in detail, and is likely to mislead. I shall be pleased to give your correspondent what information I can, having had to do with these stills for the distillation of spirits, &c.—T. W.

To the Editor of the Chemical News.

Sir,—I am very glad to be able to endorse the feeling in "Frank's" letter of last week but one. Such a society as he proposes should surely soon be got together and in working order; and I would propose Manchester as a centre for the local society of Lancashire manufacturers. That it would be of great benefit to its members can scarcely be doubted. The old days when manufacturing *chemists* were, the bulk of them, simply a set of quacks and dabblers in drugs are over, or at any rate nearly so, and with them have gone most of the petty jealousies and paltry pickings and stealings of secrets, mean spying, and all the other offspring of the then state of ignorance (it is no longer a reproach to be called a theoretical chemist). I myself have perceived what must have made itself apparent to many others, that a much better and healthier tone has arisen within this last twenty years. A conversation with a fellow manufacturer or manager is no longer a fencing match—an attempt to acquire the largest amount of information, at the same time imparting as little as possible. There is much knowledge of such a general kind that can be imparted without at all impoverishing the giver. It makes no one the poorer to say the size and strength of the timbers for a vitriol chamber, or how much sulphur or pyrites he burns for a given chamber space: all this forms simply common gossip. The Literary and Philosophical Society of Manchester only partly serves "Frank's" object; its tone is more high science, with only comparatively a sprinkling of technology, whereas the proposed society, I take it, would confine itself to questions of a technical bearing only. In conclusion, I can only add that I shall be glad to render all the assistance I can in carrying out the movement.—I am, &c.,

Peter Hart.

Ardwick Bridge Chemical Works,
Manchester.

THE CAVENDISH SOCIETY.

To the Editor of the Chemical News.

Sir,—As one who has benefitted by the publications of the Cavendish Society, and desires a continuance, I wish to know if there is any reason why it is not, as in years gone by, busily engaged in the translation and publication of English and foreign works treating of the various branches of the science studied with such lasting effect by him whose name it bears? Is it that its object is now less important than it was at its foundation? Are there not now-a-days works published—or which would be published if any sufficient inducement were offered—here, on the Continent, and in America, of equal sterling worth to those published hitherto by the Cavendish Society, which remain either entirely, or to a great extent, unknown to us in Britain for want of some such Society to carry on this work? Or is it, that though the object is as important as ever, and the material as abundant, the society must be dissolved for lack of funds?

The above, it appears to me, are the main reasons why such a society should be allowed to decline, and none of them I am persuaded, nor all combined, are of such weight at the present time as to render it necessary to give up the Society altogether. Perhaps some of those concerned in the management may be able to furnish reasons why it has sunk to such a low ebb; but is it not a matter to be urged upon the consideration of the Council—if such still exists—to revive, and re-model as far as necessary, the existing society, and to continue the good work which it has so well done in the past?

Are there not some of the works of its founders and officers,—Faraday, Graham, Hofmann, Daubeny, Miller, Stenhouse,—as well as others, which are so scarce that their publication by the Society would be a boon to many, and which would remunerate the Society for its trouble in publishing them?

Mr. C. Tomlinson, in his letter of January 24, 1870 (Chemical News, vol. xxi., p. 44), spoke of the dissolution of the Society on Messrs. Harrison having com-

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pleted the publication of the works in hand. Perhaps he, or Mr. Watts, will favour us through your columns with the views of the Council on these points, and it is to be hoped that by bringing the matter before your readers their attention may be arrested, and the result may be such expressions of opinion and interest as will lead to the resuscitation of this useful Society. That such may be the case is the wish of—Yours truly,

W. H. WOOD.

Halifax, July 5, 1872.

MISCELLANEOUS.

Royal School of Mines.—At a meeting of the Council held on July 6, the Associateship was conferred on the following gentlemen:—Mining and Metallurgical Divisions—O. Pegler, W. Charlton. Mining and Geological Divisions—G. M. Dawson. Mining Division—E. Dillon. Metallurgical Division—F. W. Harrold, J. H. Huxley, O. F. Monday, A. G. Phillips. The following awards were made:—First year students—The two Royal Scholarships, £15 each, to Mr. S. A. Hill and to Mr. J. Taylor. Second year students—H.R.H. The Duke of Cornwall's Scholarship to Mr. Edgar Jackson, the Royal Scholarship of £25 to Mr. C. Law, and the Murchison's Medal and Prize of Books in Geology to Mr. S. W. Davies. Third year students—The Edward Forbes's Medal and Prize of Books in Natural History and Palæontology to Mr. G. M. Dawson. The De la Beche Medal and Prize of Books in Mining to Mr. W. Charlton.

New Quicksilver Assay.—The following description of a new method of assaying quicksilver ores, by A. Eschka, is taken from the *Berg-und huttenmannische Zeitung*. The new assay may be used for cinnabar, mercuriferous Fahlerz, &c. The ore should be weighed in a balance turning with one milligramme. The quantity of ore for the assay varies according to its richness, as follows:—

Ore containing up to	1	per cent		10
,,	1 ,,	10 ,, ...		5
,,	10 ,,	30 ,, ...		2
,,	over	30 ,, ...		1

The ore is introduced into a porcelain crucible, the edge of which has been ground flat, and mixed with about half its weight of clean iron filings, by means of a glass rod, and is then evenly covered with a layer of iron filings about ¼ to ⅛ inch thick. A concave cover, made of fine gold, about 2 inches in diameter and 12 to 15 grammes in weight, is now placed on the crucible after having been carefully weighed; the concavity is filled with distilled water and the crucible placed on a triangle and heated for ten minutes by a Bunsen burner or Argand spirit-lamp, during which time the mercury is volatilised and deposits itself on the gold. The gold cover is then removed, the water poured off, and the mirror of mercury on the convex side washed with alcohol from a wash bottle. After being dried in the water-bath the cover is allowed to cool thoroughly, and is then weighed in a balance turning with ½ milligramme with 50 grammes in the pan. The increase of weight gives the quantity of quicksilver in the ore. During the weighing the cover is placed on an empty porcelain crucible. The quicksilver is then driven off by heating the cover gently in the flame of a Bunsen burner or a spirit-lamp, in a place where there is a good draught, and the empty crucible and cover are subjected to a second weighing as a check. In order that the assay should succeed the following conditions must be fulfilled:—The cover must fit closely, so as to avoid loss of quicksilver, and must be deep enough to hold a sufficient quantity of water to keep it cool. The iron filings must be free from grease, which would prevent the proper formation of the mirror; the washing with alcohol must not be omitted, as it removes all the bituminous substances, which spoil the mirror and assist the drying; drying in a water-bath for two or three minutes; cooling in the exsiccator; weighing when fully cool. When assaying rich ores the alcohol used in washing the cover must be collected, as it may contain a little amalgam; it must be poured into the concavity of the cover, which will take up any little globules of quicksilver. The most exact results are obtained in the case of poor ores containg less than 10 per cent.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, June 10, 1872.

In addition to several important papers relating to mechanical, mathematical, and natural history sciences, this number contains the following papers more particularly bearing upon chemistry:—

New Method of Printing upon Woven Tissues by means of Metallic Precipitates.—E. Vial.—The author describes, at considerable length, a peculiar process of printing upon woven tissues, by first impregnating the same with a solution of nitrate of silver, or of any other metallic salt which, on being brought into contact with either metallic zinc or copper, is so decomposed as to set the metal free, and next printing on the tissue so treated a pattern by means of zinc or copper plates; the result being that, wherever contact between the metal and tissue (treated as just mentioned) takes place, there is formed a precipitate of the metal (silver, in case the woven fabric were impregnated with nitrate of silver), which is at once indelibly fixed to the cloth, presenting, according to the strength of the silver solution employed, a colour varying from a bright grey to an intense black. The colour is exceedingly fast, resisting the action of alkalies, acids, and soap.

Researches on the Trichloracetates.—A. Clermont.—After briefly referring to his former researches on this subject (see CHEMICAL NEWS, vol. xxv., p. 202), the author describes—Acid trichloracetate of ammonia, $NH_4O,HO,2(C_2Cl_3O_3)$. This salt is not decomposed at the ordinary temperature of the air, but on being heated it gives off trichloracetic acid, while chloride of ammonium is formed. 100 parts of the salt contain—Ammonia, 7·55; trichloracetic acid, 89·82; water, 2·63. Acid trichloracetate of thallium, $TlO,HO,2(C_2Cl_3O_3)$, a beautifully crystalline salt obtained by dissolving carbonate of thallium in an excess of trichloracetic acid. 100 parts of this salt consist of—Oxide of thallium, 40·0; trichloracetic acid, 58·30; water, 1·70. Neutral trichloracetate of thallium, $TlOC_2Cl_3O_3$, also a crystalline body, contains, in 100 parts—Oxide of thallium, 57·84; trichloracetic acid, 42·16. As regards the action of permanganate of potassa upon hydrate of chloral, it appears that the salt just alluded to oxidises hydrate of chloral very energetically, the result being the formation of trichloracetic acid, which remains in the liquid combined with potassa.

June 17, 1872.

This number contains the two following papers relating to chemistry:—

Combination of Stannic Acid with Anhydrous Acetic Acid.—M. Laurence.—By heating to 150°, in a sealed tube, a mixture of 2 parts of anhydrous acetic acid and 1 part of meta-stannic acid, previously dried at 100°, there is obtained a syrupy liquor, which deposits, on cooling, long needle-shaped crystals. On being first roughly dried between folds of filtering-paper, and then in vacuum, they lead, on analysis, to the following cyphers, in 100 parts:—Tin, 33·33; acetyl, 48·58. Formula—

$$SnO_2\left[\begin{matrix}(C_2H_3O)\\(C_2H_3O)\end{matrix}O\right]$$
$$Sn_3O_4\ (C_{16}H_{12}O_{12})$$

When the same crystals are washed with anhydrous ether until that fluid takes up no more acid, and the substance is again dried in vacuum, the percentical composition is the following:—Tin, 46·81; acetyl, 34·1. Formula—

$$SnO_2\begin{matrix}(C_2H_3O)\\(C_2H_3O)\end{matrix}O$$
$$Sn_3O_4(C_8H_6O_6)$$

When the crystals are exposed to air, they become amorphous and

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exhibit a vitreous mass, which, on being analysed, led to the following results:—In 100 parts—Tin, 56·19; acetyl, 21·0. Formula—

$$SnO_2\left(\frac{C_2H_3O}{H}\right)O$$
$$Sn_2O_4(C_4H_4O_4)$$

New Phospho-Platinic Compound derived from Toluidine.—G. Saillard.—After first referring to Dr. Schützenberger's researches on phospho-platinic compounds, the author states that, by heating an alcoholic solution of the ether, $Ph(C_2H_4O)_2PtCl_2$, with an excess of crystallised toluidine, there is obtained a product which, after having been purified and dried at 100°, yields, on analysis, the following percentical results:—Ph, 5·73; C, 28·83; H, 4·43; N, 2·59; Pt, 36·43: Cl, 13·12. The reaction which takes place is exhibited by the following formula:—

$$Ph(C_2H_3O)_2C_7H_8NPtCl_2 + KHO = 2KCl + Ph(C_2H_3O)_2C_7H_8NPt(HO)_2.$$

This number contains some very important papers and memoirs bearing upon meteorology, astronomy, natural history, and geology.

La Revue Scientifique de la France et de l'Etranger, June 22, 1872.

This number, delayed in transmission, contains no original papers relating to chemistry, but we may call attention to the following important memoir:—

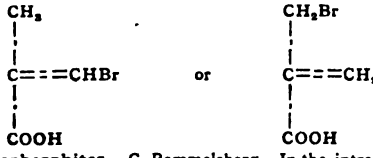
Civilisation Considered as Accumulated Force.—L. Dumont.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 11, 1872.

This number opens with an admonition on the part of the treasurer of the Society, whereby the members are reminded that, in accordance with section 23 of the statutes, any member who, after having been twice requested in writing to pay his contribution, fails to do so, ceases to be a member *hoc ipso facto*, and his name is peremptorily struck from the roll.

The following original papers and memoirs are contained in this number:—

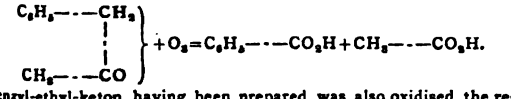
Isobutyric Acid from Citra-bibrom-pyrotartaric Acid.—F. Geromont.—The main gist of this short paper is that, according to the researches of Kekulé, the acid obtained by the action of sodium amalgam and water upon citra-bibrom-pyrotartaric acid must be constituted according to either of the two following formulæ:—



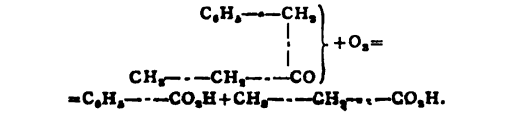
On Hypophosphites.—C. Rammelsberg.—In the introduction to this lengthy memoir, the author reviews the labours of Dulong, H. Rose, H. Davy, Würtz, and others on this subject. The mode of decomposition of the salts alluded to, when exposed to the action of heat, is then discussed at great length. It appears that in some cases the result of the decomposition of hypophosphites by heat is the formation of a mixture of pyro- and meta-phosphate. The hypophosphites of nickel and cobalt leave, on ignition, a mixture of meta-phosphate and phosphuret of the metal. Hypophosphite of ammonium yields, on ignition, 1 molecule of pyrophosphoric, and 2 molecules of meta-phosphoric acids. The hypophosphite of uranium is converted into phosphate of protoxide of uranium, a conversion attended with explosion, in consequence of the sudden evolution of hydrogen gas.

Most Simple Method of Determination of the Molecular Weight as Deducted from the Volume of Vapour.—H. Landolt.—This paper is illustrated with a woodcut, the reproduction of which would be essentially required for the proper understanding of the contents.

Oxidation-Products of the Benzyl-Ketons.—A. Popoff.—In the introduction to this essay, the author discusses the general principles of the oxidation of the benzyl-ketons, and next treats on benzyl-methyl-keton, which, having been obtained in a state of perfect purity, and exhibiting all the properties described by Radziszewsky, was oxidised by means of bichromate of potassa and sulphuric acid, yielding benzoic and acetic acids. This oxidation took place according to the following formula:—



Benzyl-ethyl-keton, having been prepared, was also oxidised, the result being the formation of benzoic and propionic acids. This reaction is elucidated by the following formula:—



Concentration of Sulphuric Acid.—R. Hasenclever.—Reserved for full translation.

Heat of Formation of the Nitrogen Acids.—J. Thomsen.—This paper is a criticism of the labours of Berthelot on this subject.

Contribution to our Knowledge on Cholesterin.—W. Loebisch.—This essay treats on—The products of oxidation of cholesterin, viz., a new acid, $C_{24}H_{40}O_6$, a solid, crystalline body, readily soluble in alcohol, ether, and warm acetic acid; acetyl-cholesteryl, also a solid crystalline compound, formula—

$$C_{26}\left(\frac{C_2H_3O}{H_{43}}\right)O;$$

cholesterylamin, $C_{26}H_{43}NH_2$. The author quotes the cholesterin compounds in the following manner:—Cholesterin, $C_{26}H_{43}.OH$ sodium-cholesterylat, $C_{26}H_{43}.ONa$; acetyl-cholesteryl—

$$C_{26}H_{43}.OC_2H_3O;$$

chlorcholesteryl, $C_{26}H_{43}.Cl$; cholesterylamin, $C_{26}H_{43}.NH_2$.

Nitro Compounds of the Fatty Series.—V. Meyer and O. Stüber.—This, the second instalment of a lengthy monograph on this subject, is divided into the following sections:—Metallic derivatives of nitro-ethan; nitro-methan.

Absorption of Ozone in Water.—L. Carius.—The author has instituted a series of experiments from which it appears that ozone is measurably absorbed by water, and that in the commercially-sold ozone-water (at Berlin, Krebs, Kroll, and Co., manufacturers) there is really contained ozone (not nitrous acid or peroxide of hydrogen) to an amount of about 4·45 c.c. in 1000 c.c. of water at 0° and 0·76 m. barom.

Some of the Pigments and Dyes derived from the Aromatic Azo-Diamines.—Dr. A. W. Hofmann and A. Geyger.—This second portion of a monograph on this subject treats on—Safranine; chlorhydrate of safranine; platinum salt of safranine; the free base; nitrate of safranine; picrate of safranine; iodhydrate of safranine; sulphate of safranine. The eminent authors call attention to the curious coincidence of the formulæ of safranine, $C_{21}H_{20}N_4$, and Perkin's mauvein, $C_{27}H_{24}N_4$, stating that the latter might almost be considered as phenylated safranine, $C_{27}H_{24}N_4 = C_{21}H_{19}(C_6H_5)N_4$. When safranine is boiled with aniline, a violet dye is obtained; and when treated with concentrated acids, safranine and mauvein yield the same reactions.

Les Mondes, July 4, 1872.

Native Vegetable Ink.—Rev. F. Moigno.—The author states that experiments are being made to acclimatise in Europe the *Coriaria thymifolia*, or ink-plant of New Grenada. The juice of this plant, locally termed *chanchi*, is at first of a somewhat reddish colour, but becomes intensely black in a few hours. This juice can be used for writing without requiring any further preparations; it corrodes steel pens less than ordinary ink, and has, moreover, the advantage of better resisting chemical agents. When the portion of America named above was under Spanish dominion, all public documents were written with chanchi, which was not removed from paper by sea-water.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, April 25, 1872.

Gas-Making Apparatus for Domestic Use.—M. Symer.—The detailed description of an apparatus suited for the manufacture of illuminating gas, more especially for use in dwelling-houses, country seats, railway stations, &c., situated at a great distance from public gas-works.

Newly-Devised System of Purifying the Condensation Water of Low Pressure Steam Engines.—MM. Cail and Co.—The authors first refer to the various methods now in use for purifying—that is to say, freeing from grease and oily matters—the condensed steam of the low pressure engines, so as to render the resulting water fit for use again as feed-water of the boilers. They next describe their invention, which mainly consists of a contrivance by which the water is agitated with benzoline (light petroleum oil), which dissolves the fatty matters, leaving the water in a pure state. The benzoline may be rendered, after having become saturated with fatty matters, fit for renewed use by distillation, while the fatty substances may be used for soap-making and other purposes. From the authors' experiments it appears that from 1-5th to 1 grm. of fatty matters per horse-power is daily taken up by the condensation water; benzoline of good quality can take up more than half its weight of fatty matters before becoming inactive; other liquid hydrocarbons may also be taken.

Note on the Native Calcareous Phosphates (Phosphorite) of the Département du Lot.—C. Mène.—This paper, illustrated by woodcuts exhibiting sectional views of the quarries, gives a detailed account of the exploitation of this mineral, now carried on on a large scale.

Testing of Wine, Beer, and Vinegar.—Dr. Duclaux.—The author, briefly describing a system of testing the relative value of the liquids referred to, states that, when alcoholic or acetic liquids are caused to pass drop by drop from a narrow orifice, these drops are heavier in relation to the larger quantity of alcohol or acetic acid contained in the liquid under examination. Special apparatus are to be used for this method of testing.

Bibliography.—Under this heading we notice the following work:—"La Pomme de Terre sa Culture, son Emploi et sa Conservation," by M. E. Vianne, Paris.—A. Saguier.—This work,

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illustrated by woodcuts, is very highly spoken of. The author, an eminent agriculturist, treats the subject agriculturally as well as industrially.

May, 2, 1872.

Bone-Black Manufacture.—C. Mène.—The detailed account of the modes and process of bone-black preparation as carried on by MM. Dunod and Bougleux. This industry includes, besides bone-black for sugar-refining purposes, the manufacturer of empyreumatic oil, bone-grease, sulphate of ammonia, superphosphate of lime, bone-dust, bone-ash, and bone-black for paint and blacking purposes.

Description of Apparatus for the Preparation of Gases in Chemical Laboratories.—J. Salleron.—Illustrated by woodcuts. The author gives an account of well and strong made cast-iron apparatus suited for making oxygen, coal-gas, and other gases, which require a strong heat for their preparatiou.

Continuation of the Essay on Dynamometers.—C. Mène.

Liquefied (Condensed) Sulphurous Acid Gas for the Preservation of Beet-roots.—Ch. Tellier.—Sulphurous acid gas is condensed and forced into portable vessels made of cast-iron, and the liquid dispersed through the beet-roots, which are kept in pits dug in the field and covered by earth; the gas is liquefied on the large scale by the combined agency of pressure and cold.

Bromine Water as a Test for Phenol.—C. Mène.—When bromine water is added in excess to a weak aqueous solution of phenol, there is formed a yellowish white precipitate of tribromophenol; this reaction is so sensitive that 1 part of phenol (carbolic acid) in 43·70 parts of water, that is 0·0229 grms. to the litre, can be detected; in case of any doubt arising as to the nature of the precipitate, it is separated by filtration, washed, and put into a test-tube, gently heated along with some sodium amalgam; the liquid is then poured into a beaker-glass, and upon the addition of a few drops of dilute sulphuric acid the characteristic smell of phenol will be perceived, and the substance becomes visible in the shape of oily drops.

Bibliography.—Under this heading we meet here with a review from the pen of Dr. Pisani of the work—"Détermination Pratique des Minéraux," by M. E. F. de Kobell. Paris: J. Rothschild, 13, Rue des Saint-Pères. It appears that this small work is a highly valuable book both for chemists and mineralogists to aid them in rapidly and accurately ascertaining the nature of minerals.

NOTES AND QUERIES.

Parnell's Process for Estimation of Arsenic in Ores.—I should feel obliged if your readers could inform me where I may obtain full particulars of Parnell's process for estimation of arsenic in ores by means of chlorine, as briefly described in Crookes's "Select Methods of Chemical Analysis."—G. W.

TO CORRESPONDENTS.

C. A. Priestley.—Apply chlorine-water with a camel's-hair brush, and wash with distilled water.

W. Morgan Brown.—We are obliged for the copy of Lightfoot's "Chemical History and Progress of Aniline Black."

G. E. Davis, W. H. Wood, and W. E. Bickerdike.—Received with thanks.

W. W.—There is a good article on indigo in the English edition of Wagner's "Chemical Technology," just published by Messrs. J. and A. Churchill.

W. P.—Consult Watts's "Dictionary of Chemistry."

B. Westermann and Co. (New York).—We have just received a letter from these correspondents, from which we quote the following:—"In Chemical News, vol. xxv., p. 71, under the heading "Bibliography," you state the price of Knapp's "Technische Wandtafeln," 64 coloured plates, &c., as £6 10s., which is evidently a mistake, the price for each of those 64 plates being R. 2. 10 groschen, or 7s. English, if four are taken at once; single plates selling at R. 2. 25, or 8s. 6d. The entire collection of 64 plates would cost, therefore, at 7s. each, £22 8s., and not £6 10s." We hasten to rectify the error, which, however, was not ours, as we correctly translated the price from the German periodical.

BOOKS RECEIVED.

Experimental Chemistry. Founded on the Work of Dr. Stockhardt. By C. W. Heaton, F.C.S. Bell and Daldy.

Proceedings of the Newcastle-upon-Tyne Chemical Society.

Tenth Annual Report of Charles A. Cameron, Ph.D., M.D., City Analyst to the Corporation of Dublin.

Contributions to Molecular Physics in the Domain of Radiant Heat. By John Tyndall, LL.D., F.R.S. Longmans and Co.

The New Patent relating to the Sewage of Towns. By J. Brough Pow, Esq.

The Journal of the Iron and Steel Institute. Vol. I. 1872.

The Retrospect of Medicine. Edited by W. Braithwaite, M.D., and James Braithwaite, M.D. Vol. LXV., Jan.—June, 1872. Simpkin Marshall, and Co.

Report of the Committee appointed to Test Steam Boilers at the American Institute Exhibition. From Prof. R. H. Thurston.

A Handbook of Chemical Technology. By Rudolf Wagner, Ph.D. Translated and Edited from the 8th German Edition by William Crookes, F.R.S. With 336 Engravings. J. and A. Churchill.

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THE CHEMICAL NEWS.

VOL. XXV. No. 660.

ON THE DETECTION OF ORGANIC AND OTHER NITROGENISED MATTER EXISTING IN THE ATMOSPHERE.*

By ALFRED HUTCHISON SMEE, F.C.S.

IN this communication the author describes a method which he has devised, and which he names "distillation by cold," by which he believes the detection and determination of ammonia aud other organic impurities existing in the atmosphere will be greatly facilitated.

A glass funnel (usually of 8 or 9 inches) is drawn to a point and closed. It is supported in an ordinary stand, and filled with ice. Condensation of the watery vapour of the atmosphere then takes place; the dew collects into drops, which trickle down the outside of the funnel, and at last fall from the point, under which a small receiver is placed to catch them. The total quantity of liquid collected in a given time is measured, and the quantity of ammonia determined by Nessler's test.

By the method of distillation by cold, the author found it possible to distil many substances which are decomposed at a high temperature. Thus many delicate odours of flowers were distilled by placing the flowers under a bell-glass sufficiently large to cover the funnel containing the ice. The odours were found to be more rapidly and completely abstracted by placing a dish with a little ether under the bell-glass at the time of distillation.

The Paper was accompanied by tables giving the results obtained in 107 experiments, together with the atmospheric conditions prevailing at the time. The experiments were made in a garden, in a bed-room, in hospital wards, in the open country, &c. A few of the numbers obtained are here given by way of example:—

Fluid collected in minims.	Ammonia in grains per gallon.	Source.
150	1·9712	Erysipelas.
120	0·1791	Garden.
55	6·8807	Drains.
90	2·1000	Bed-room.
	2·9568	Stables.
150	0·0985	Victoria Park.

IMPROVEMENTS IN CHLORIMETRY.

By GEORGE E. DAVIS.

THERE is a modification of Penot's arsenic method for the estimation of the available chlorine in bleaching-powder now extensively used in commercial laboratories. It has not, however, found its way into many text-books on analysis; the process is as follows:—

Standard Solution of Arsenious Acid.—Weigh off 13·95 grms. of arsenic trioxide, dissolve in caustic soda solution, dilute largely with water, acidify with hydrogen chloride, and dilute exactly to a litre. 10 c.c. of this solution correspond to 0·1 grm. chlorine.

Indicator.—A concentrated solution of indigo sulphate.

Preparation of the Solution of Bleaching-Powder.—After well mixing the sample, weigh off 5 grms. of the powder and rub up with water to a paste, add more water and allow to settle, pour off the nearly clear liquid into a 250 c.c. flask, and repeat the operation until the whole of the powder has been transferred to the flask in the state of solution and fine division, then fill up to the mark with water.

The Analysis.—Take 10 c.c. of the standard solution of arsenious acid, place in a small flask, and add a drop of the indigo sulphate solution. Fill a burette (Gay-Lussac's I prefer) with the bleaching-powder solution which has been well agitated, and add it cautiously to the arsenious acid until the blue colour of the solution is replaced by a brownish yellow. The number of c.c. used must then be divided into 500, which will give the percentage of available chlorine in the powder under examination.

Some operators object to use the process because they say it gives low results, for an excess of bleaching-powder solution is required to oxidise the indigo sulphate, and the more bleaching-powder used the lower the results. This is true partly, but only *one drop* is required to oxidise the indigo, just as one drop in excess of hyposulphite is required to decolourise the iodide of starch in Bunsen's method.

Then, again, others say that it is not advisable to run the bleaching-powder solution into an acid solution, as some chlorine might be liberated and lost. Such objections as these are only puerile, and do not in the least tend to weaken the liking many operators have for the process, those who have tried it and have found it to work most satisfactorily. Now to work upon the theory of the process, all that is wanted is to dissolve the arsenic trioxide in a substance which shall be inactive, as far, at least, as regards the arsenic trioxide, the indigo sulphate, and the bleaching-powder solution. Water will not dissolve the oxide without a great deal of trouble; alkalies dissolve it easily with the production of arsenites, but these alkalies have to be taken up again by adding stronger acids, being only used for easily obtaining the arsenic in a soluble form; but glycerine dissolves arsenic trioxide easily; glycerine is not acted upon by the bleaching-powder solution or by the indigo sulphate, therefore it is specially adapted for the preparation of the standard solution. I now prepare my standard solution thus:—13·95 grms. of arsenic trioxide (which has been powdered in an agate mortar) is heated in a flask with 40 c.c. of pure glycerine until it is all dissolved; the solution is then diluted with distilled water to a litre, when it is ready for use. It is of course of the same strength as that prepared by dissolving in caustic soda and afterwards acidifying with hydrochloric acid, and is used in exactly the same way.

A litre of solution was made by each method and was used side by side for a long series of trials, in order to determine whether the method was reliable or not, with the following results:—

	Bunsen's Method.	Arsenic dissolved in Alkali and Acid.	Arsenic dissolved in Glycerine.
1.	36·72	36·64	36·64
2.	29·82	29·71	29·78
3.	25·86	25·80	25·80
4.	26·58	26·58	26·66
5.	31·33	31·42	31·38
6.	34·41	34·36	34·36
7.	7·16	7·04	7·06
8.	7·18	7·11	7·13
9.	8·33	8·42	8·39

The last three were samples of bleaching liquor, the first two of which were warranted to contain between 7 and 8 per cent of available chlorine and the third 9 per cent.

I find there is a method for testing bleaching-liquor, used in several manufactories which gives an error directly as the specific gravity of the liquor. The analysis should be conducted as described above, but the bleaching-liquor solution should be made as follows:—25 c.c. of the liquor should be diluted to 250 c.c., and then added to the arsenious acid solution, the number of c.c. used multiplied by the specific gravity, and divided into 100 will give the percentage of available chlorine in the liquor. Now some forget to divide by the specific gravity, consequently the percentage is expressed higher than it really is, to the

* Abstract of a Paper read before the Royal Society.

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extent of about 1 per cent, for 25 c.c. are in the calculation reckoned as 25 grms., whilst in reality the weight is 28·5 grms. if the liquor possesses a density of 28° Twaddle, which is 1·14 specific gravity.

The turbid solution of bleaching-powder must always be used, and never filtered, or be allowed to settle; for the clear liquid always gives lower results, showing that the insoluble portion carries down chlorine with it, as the following analyses will show:—

	Bunsen's.		Modified Penot's.	
	1.	2.	1.	2.
Turbid ..	38·14	38·09	38·00	38·21
Clear ..	37·41	37·60	37·36	37·72

These determinations were made upon two different weighings of the same powder. No. 1 was brought into solution and estimated first by Bunsen's method, and then by the modified Penot's; the liquor was then allowed to settle, and the clear fluid examined. No. 2 weighing was served in the same manner.

The absence of this method in two at least of our best text-books, and the easy way of preparing the arsenious solution in glycerine, with the advantage of the indicator being in the solution itself, led me to describe it. It is not for the scientific analyst I have done so, but for many manufacturers and consumers of the article who, perhaps, are only acquainted with imperfect or indirect methods: but the solution in glycerine is a novelty; at least I have never seen it described before.

Radcliffe, July 2, 1872.

ON PYRO-PLATING.

By J. BAYNES THOMPSON.

The end of pyro-plating, like that of all other methods of plating, is to affix to a baser metal a sheet of one of the superior metals; but this method is applicable where none of the other methods can be applied with success.

"Close plating," whether with hard or soft solder, cannot be applied with success to any cutting instrument, as a knife or a pair of scissors, &c. Hard soldering would completely destroy a knife-blade or a pair of scissors. The soft solder plating can be applied to a knife or a pair of scissors without destroying the steel, though with difficulty; with the scissors the first attempt to cut would shear off the plating, and with the knife, if it were sharpened so that it would cut, the plating would chip off in using it. Common electro-plating is not applicable to steel or iron, as by that method these metals cannot be got perfectly clean, that is—chemically clean, therefore by that method no adhering coating can be obtained.

In fact, for all manner of plating or soldering, the first requisite is, that the two metals that are to be applied to each other must be chemically clean, or no proper adhesion can be obtained.

This cleanness is obtained in various ways. In soldering by various fluxes; in electro-plating to such metals as that method is applicable; by dipping the article in an acid which will readily dissolve the metal of which it is made,—and not only so, but the salt formed by this solution of the metal in the acid used, must be readily soluble in water, or no clean surface can be obtained. There is still another condition to be considered, that is when the surface of the metal has been made thoroughly clean, it must be protected from contact with the air in its transit from the cleansing-baths to the solution wherein it is to be coated. This condition not being recognised in the first attempts at electro-plating caused many failures and much trouble, till it was discovered that a film of mercury prevented the contact of the air with the cleaned metal. Moreover, mercury has this advantage, that it amalgamates with the metal to be coated, and with the coating, though this amalgamation is not absolutely necessary, yet it facilitates the coating of metals with other metals by electro-deposition, when the two metals will readily amalgamate.

There are cases where amalgamation is not possible; for example, where one of the metals will not amalgamate, as with steel and iron coated with copper, gold, or silver; or when neither will amalgamate, as with steel or iron coated with aluminium or nickel; not that it is impossible to form an amalgam with these metals, for even steel can be amalgamated by the intervention of sodium, but it is not possible for plating purposes, as a diluted solution of a mercuric salt must be used.

Now for all such cases as these where the amalgamation process cannot be used, pyro-plating is especially applicable. The name pyro-plating is given to this process to distinguish it from the Electro-plating process, and because the coating is driven into the surface of the metal on which it is put by means of heat and pneumatic pressure. It is not confined to coating with silver as its name might indicate, but it is at present applied to coating with gold, platinum, silver, nickel, aluminium, copper, brass, or bronze and aluminium bronze.

The *rationale* of the process is very simple; but the various details require much care and attention.

The end to be obtained is simply this. That the metal to be coated shall be "chemically clean" when immersed in the solution in which it is to be coated. There are several ways in which the attainment of this end may be prevented. By inadequate means for cleansing, by the passage through the air of two or three feet after being cleansed, by the metal being positive in the coating solution,—in this case the metal is fouled on contact. This refers to cyanide solutions, to sulphate and chloride solutions, to double sulphates and chlorides, as of nickel and ammonia, and of platinum and potash or soda. All of these may be used in certain cases for pyro-plating, but they are *not* used. There is a special solution used for pyro-plating in all cases, because most of these solutions leave matters in the metal that is being coated, if it be in the slightest degree porous or "roaky," as is the case with steel that has been badly faggoted, and on the article passing through the furnace these matters volatilise, and cause an irruption in the coating. The method used for cleansing steel and iron articles is as follows. They are first boiled in caustic alkali to free them from grease; they are then mechanically cleaned with fine flour emery and brushes in water; they are then brushed with steel wire brushes under a stream of a solution of carbonate of soda; then they are wired and hung in the same solution ready for being made chemically clean. This is done by means of nascent hydrogen in a hot alkaline solution. The water of solution is decomposed on the article by means of a strong current of electricity, the article being made negative. If the solution be kept strong and not carbonised, a film of this solution is sufficient to protect the article from contact with the air in its quick transit from the last purifying process to the solution wherein it is to be coated. The time for it to be transferred can easily be seen by the experienced eye; the article assuming gradually a more silvery appearance. After the proper amount of metal is put on in the coating bath the articles are taken out and washed and dried. The amount of metal put on is ascertained by having a test-surface put in with the articles, and the exact time of putting in and the exact weight of the test noted, and this test is carefully weighed from hour to hour till the amount desired is put on. After being dried, the articles are put into the furnace to have the silver or other metal driven into the surface of the coated metal. The firing furnace, as it is technically called, is of simple construction. The conditions to be observed in its construction are two, namely to obtain a bright red heat in the chamber where the articles are put, and to secure the articles from coming in contact with the fuel or products of combustion. In firing knifes-blades and other cutting instruments care has to be taken that they are not carried higher than

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between 450° and 500° F. This is ascertained by trials on a pad of prepared test paper; a blade is taken out from time to time and tried upon the pad and the colour is noted—whether it scorches it straw-colour, yellow, pale brown, deep brown, or black. Alum-water is used for regulating this paper as to the colour for the proper degree of heat. After the proper heat is attained the blade is instantly quenched point downwards in cold water and all that were in the firing chamber with it. For articles that do not require tempering or that are made of metal that will not temper, as iron, copper, good brass, or German silver, the heat may be higher. Even if a steel article should be carried so high as to soften it, it can be re-hardened and tempered with the silver or other metal upon it, without in any way injuring the coating. The theory of this part of the process which is technically called "burning in," is this. The coating metal in all cases is one of the superior metals as compared with the coated metal, and is less porous whether cold or hot.

The article being heated, it naturally expands and becomes more porous, as of course both article and coating do, but their relative porosity remains the same, consequently on expansion there will be an infinite number of small cists into which by atmospheric pressure the coating will be driven on attaining the proper heat. Then on the instantaneous quenching in cold water, the coating is seized and retained by the suddenly contracting under metal. This is seen to be the case on filing or grinding the coating off the under metal; for though the coating may be filed or ground off till both coating and under-metal are filed or ground off together, yet the under-metal remains spotted all over with an infinity of little points of the coating metal.

Whitehall, July 3, 1872.

ANALYSIS OF POTASHES.—METHOD OF M. O. HENRY.

By F. HAMEL.

THE alkalimetric test of commercial potashes gives, as is known, by alkalimetry, the amount of carbonate of potassa contained, when this salt is not mixed with anything but insoluble substances or with other salts of potassa; but it in no way indicates the amount when they are mixed with soda. In order to discover in this case the potassa, and to estimate it, M. O. Henry has proposed the following process, to which he gives the name *Potassimetry*.

This process depends on the property, which potassa possesses, of forming with perchloric acid a salt completely insoluble in alcohol, while the corresponding soda salt is soluble. This last is therefore used as a reagent for precipitating the potassa. It is procured as follows:—

Chlorate of potassa is heated carefully in a platinum dish until the disengagement of oxygen ceases, and dissolved in twenty times its weight of boiling water; filtered through muslin, and allowed to cool, meanwhile stirring to render the crystals small. The perchlorate of potassa is deposited in small white grains, which are washed with a little cold water, and dried in the air-bath. It is afterwards reduced to a fine powder, placed in a large test-tube, in the bottom of which has been put some mercury, and 5 to 6 parts of pure water added. On one side is placed, in a sandstone retort, a mixture of two-thirds fine, clean sand, and one-third of a mixture of fluor-spar and sulphuric acid in the proportion of one to three; an exit tube is fitted to the neck of the retort, the extremity of which tube dips under the mercury in the test-tube. The retort is then heated, hydrofluosilicic acid is disengaged, which passes through the mercury, reacts on the perchlorate of potassa, forming a gelatinous hydrofluosilicate of potassa, which is insoluble, and freeing the perchloric acid. The reaction being finished, the magma produced is thrown into a linen carrelet, washed with distilled water, and the wash-water saturated with crystallised carbonate of soda. It is then filtered, concentrated on the sand-bath to a syrupy consistency, diluted with about its weight of alcohol of 37°, heated gently, and filtered. By evaporating carefully the alcoholic solution of perchlorate of soda thus obtained it furnishes white, needle-shaped crystals, from which is prepared, as we shall see further on, the solution for titering.

The instrument used by M. Henry for titering the potassa is made thus:—

A glass tube, about 60 c.m. long and 4 m.m. in diameter, surmounted by a glass cap and terminated by a small faucet, affords a sort of burette, divided into 100 equal parts. This apparatus is borne on a foot, which serves as a support for the apparatus, but which is sufficiently high to allow a beaker glass for precipitation to be placed under the faucet. The pipette, throughout its 100°, is filled with a solution of titrated perchlorate of soda, representing, for each degree, one-hundredth of pure carbonate of potassa. This strength is readily obtained; for this purpose the amount of alcohol of 37° contained in the space of the tube, between 0° and 100°, is run from the tube, and its exact weight taken. Then 10 or 100 times the weight of that quantity of alcohol of 37° is taken, in a graduated flask, and to it is added 10 or 100 times 0·884 grm. of dry perchlorate of soda, which correspond to 1 grm. of pure carbonate of potassa.

We will now describe the working of the potassimetric test. Specimens are taken from various parts of the cask of potash to be tested, to the amount of 250 or 300 grms.; these are mixed, and reduced to a powder as quickly as possible. From this powder 50 grms. are taken, which are treated in the cold with 100 grms. of distilled water. The solution is carefully filtered, and the solution placed in a test-glass graduated into 50 equal parts.

1st. By means of a graduated pipette, 10 measures of this solution, representing 5 grms. of the potassa to be tested, are taken, and subjected to the alkalimetric test, and the alkalimetric degree obtained is noted.

2nd. One measure of the above solution, representing 1 grm. of the potash to be tested, is taken; this is saturated with acetic acid, a slight excess being added, the solution evaporated nearly to dryness, and the residue treated in the cold with alcohol of 37°, then filtered without anything being lost; the alkaline sulphates, chlorides, and silicates remain on the filter. To this liquid, representing in acetate the carbonate of potassa, and that of the soda in the potash under examination, is added, drop by drop, the titrated solution of perchlorate of soda, so long as a precipitate is observable, adding it very slowly, as the level of the liquid in the tube approaches the fortieth and fiftieth graduation. This number indicates, for 1 grm. of the potash examined, the hundredths of pure carbonate of potassa.

On considering on one side, by application of the alkalimetric test, the quantity of sulphuric acid which this potassa saturates, it is easy to arrive at the determination of the proportions of carbonates of soda and potassa mixed together. In effect 100 measures of the alkalimeter represent—

	Grms.
Sulphuric acid at 66°	5·423
Anhydrous sulphuric acid	4·429
Which is equivalent to pure anhydrous KO,CO_2	7·600
Which is equivalent to pure anhydrous NaO,CO_2	5·740

On the other side, by means of the potassimeter, the real amount of carbonate of potassa in 100 parts has been determined.

Since this amount should require of actual sulphuric acid the difference between the entire amount of this acid employed in the alkalimetric test and the amount corresponding to the carbonate of potassa determined by the potassimeter, this will give at once the carbonate of soda added, and the double problem will be solved,

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the determination of the real amount of potash present, and the proportion of carbonate of soda added.

Let us take an example to facilitate the understanding of these facts.

100 grms. of commercial potash, taken as stated, giving—

1st. By the alkalimetric test, a number of degrees representing actual anhydrous sulphuric acid, 38·9 grms.

2nd. By the potassimetric test, a number of degrees representing carbonate of potassa, 50 grms.

We have 28·9 anhydrous sulphuric acid for the 50 of pure carbonate of potassa.

The difference, 10 of acid, will represent pure carbonate of soda, 13·3 grms.—*Revue Hebdomadaire de Chimie.*

MILK ANALYSIS BY THE AMMONIA PROCESS.

By J. ALFRED WANKLYN.

The ammonia process, which Chapman, Smith, and myself applied to water analysis in the year 1867, is available for a great variety of purposes. There is a very simple application to the analysis of milk, which I propose to describe on the present occasion.

In our little book on water analysis, we gave the proportion of "albumenoid ammonia" yielded by caseine as 7·6 per cent. As we remarked, we could not guarantee the absolute purity of the caseine employed for that determination. Recent experiments, however, do not greatly modify the result. Apparently, the number was given a little too high, 6·5 being more in accordance with my later experiments. Inasmuch as normal milk contains 4·0 per cent of caseine, 100 parts of normal milk should give 0·26 part of "albumenoid ammonia," and such is the result of recent determinations.

In order to examine milk by the "ammonia process," the following method of procedure may be adopted. The milk is first diluted to a convenient degree; 5 c.c. (or, preferably, 5 grms.) of milk are placed in a 500 c.c. measure, which is filled up with water to the 500 c.c mark; the milk and water being then well mixed up together, there results a diluted milk. This diluted milk is of such a strength that 1 c.c. contains 10 milligrammes of milk. For the analysis, 50 milligrammes of milk—*i.e.*, 5 c.c. of the dilute milk—is a convenient quantity.

A tubulated retort, capable of holding about a litre, is charged with 400 c.c. of ordinary water of fair quality, such as, for instance, the ordinary river water supplied by the London water companies. Next, then, is poured into the retort 50 c.c. of alkaline solution of permanganate of potash, made by dissolving 200 grms. of solid caustic potash and 8 grms. of crystallised permanganate of potash in one litre of water. The retort is then connected with a Liebig's condenser, by means of a small piece of wide india-rubber tube, and heated by means of a good-sized Bunsen lamp, the naked flame of which may be applied directly to the retort. Distillation then proceeds. The distilled water, as it comes over, should be tested for ammonia by the Nessler test, in the manner about to be described, and by the time 200 c.c. have distilled over, will be found to be quite free from ammonia. This point having been arrived at, the 50 milligrammes of milk (5 c.c. of dilute milk) are introduced into the retort, which will then contain 250 c.c. of water, 10 grms. of potash, and 0·4 grm. of permanganate of potash. The distillation is then proceeded with as long as ammonia comes over, the ammonia being estimated by the Nessler test.

The measurement of ammonia by the Nessler test is managed as follows:—

A solution of iodide of potassium, saturated with biniodide of mercury, is first prepared thus:—35 grms. of iodide of potassium, 19·1 grms. of bichloride of mercury—are dissolved in less than a litre of water, heat being employed to assist the solution of the salts. It will be found that a slight excess of biniodide of mercury will remain undissolved—filter or decant so as to separate this small quantity of undissolved red iodide of mercury. (Should, through failure to have used the proper proportion of the salts, there be no excess of undissolved iodide of mercury, a little bichloride must be added, until the red precipitate begins to be permanent). Add, then, either 120 grms. of solid caustic soda, or 160 grms. of solid caustic potash. Dilute the liquid with water to the volume of a litre, and this is the *Nessler reagent*. Before using the *Nessler reagent*, add about 5 c.c. of strong aqueous solution of corrosive sublimate, which will occasion a slight precipitate; decant off this precipitate, and the clear liquid is fit for use. This last addition of corrosive sublimate has for its object the rendering of the Nessler reagent sensitive.

Use of the Nessler Reagent.—Into a cylinder made of colourless glass, and marked so as to be a 50 c.c. measure, put the distillate which you desire to test for ammonia. Add 1½ c.c. of Nessler reagent, which will produce a yellowish-brown colouration. Observe the depth of the colour. On a white piece of paper, side by side with the cylinder containing this coloured liquid just mentioned, place a second 50 c.c. cylinder. Into this second cylinder put pure distilled water, and add to the pure distilled water some standard dilute ammonia liquid—as many measures of the standard ammonia as you judge to be requisite. Add 1½ c.c. of Nessler reagent—a colouration will result—compare the colour with the colour of the liquid in the first cylinder. If the colours are equal, write down the quantity of ammonia you have added, and that will be the quantity contained by the 50 c.c. of distillate. If the colours are not equal, make another trial with a different quantity of standard ammonia, and so on until you get equal colouration.

The strength of the standard ammonia is such that 1 *c.c. contains* 1-100th *milligramme* of ammonia. It is made by dissolving 0·315 grm. of chloride of ammonia in one litre of distilled water, and then mixing that solution with nine times its volume of pure distilled water.

The operation of Nesslerising, as it is called, that is, the operation just described, is not difficult, as the many chemists who are in the habit of practising it have abundantly testified. There are a few little points requiring attention; thus a few minutes must be allowed to elapse before reading off the colour: the liquid must be cool, the distilled water must be very free from ammonia, &c. The distilled water used for Nesslerising is best prepared by the operator himself. A fair river water being taken, is set to distil; at first ammoniacal water will distil over, but after a time water free from ammonia will distil, and this must be tested, and then carefully preserved for use.*

The following are some examples of milk analyses by the ammonia process:—

Milk yielding 12·92 per cent of solids and 8 per cent of cream.

	Quantity of Milk taken.	Quantity of NH_3 obtained.
Exp. I.	100 milligrammes.	0·27 milligramme.
Exp. II.	50 ,,	0·13 ,,
Exp. III.	50 ,,	0·13 ,,

Milk which appeared to have been somewhat skimmed, but not watered. Solids, 11·42 per cent.

	Quantity of Milk taken.	Quantity of NH_3 obtained.
Exp. I.	50 milligrammes.	0·135 milligramme.
Exp. II.	100 ,,	0·255 ,,

Slightly-watered milk. Solids, 10·20 per cent.

	Quantity taken.	Quantity of NH_3 obtained.
Exp. I.	50 milligrammes.	0·095 milligramme.
Exp. II.	50 ,,	0·095 ,,
Exp. III.	100 ,,	0·220 ,,

* For further details, I would refer to the book on Water Analysis, by Chapman and myself.

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Highly-watered milk. Solids, 6·18 per cent.

	Quantity taken.	Quantity of NH_3 obtained.
Exp. I.	50 milligrammes.	0·075 milligramme.

Highly-watered milk. Solids, 8·10 per cent.

	Quantity taken.	Quantity of NH_3 obtained.
Exp. I.	50 milligrammes.	0·070 milligramme.

Expressed in a tabular form:—

	Per cent. Solids in Milk.	Per cent. of Ammonia.
I.	12·92	0·27
II.	12·92	0·26
III.	12·92	0·26
I.	11·42	0·27
II.	11·42	0·255
I.	10·20	0·19
II.	10·20	0·19
III.	10·20	0·22
I.	6·18	0·15
I.	8·10	0·14

In order to translate these results into percentages of caseine contained by the different samples of milk, it has to be borne in mind that 6·5 parts of ammonia correspond to 100 parts of caseine. The ammonia, therefore, when multiplied by 100 and divided by 6·5 indicates the caseine. In conclusion, the ease and rapidity of these determinations may be referred to. In half an hour an analysis of milk by the ammonia process may be easily made.—*The Milk Journal.*

ON THE

EVIL EFFECTS OF THE USE OF ARSENIC IN CERTAIN GREEN COLOURS.*

By FRANK W. DRAPER, M.D.

EVERYBODY knows that arsenic is a deadly poison. Its name at once suggests to the popular mind a virulence of action possessed by only a few of the kindred agencies which are placed at the disposal of mankind. Although recognised by the physician as a valuable remedy under certain conditions, its administration is advisedly attended with special caution, its minimum dose being fixed at a very small fraction of a single grain. Murderously-disposed men have found it a quick and subtle means for the accomplishment of their malicious purposes; and discontented mortals, tired of life, have taken it as an efficient instrument for self-destruction. In acknowledgment of its deadly power, wise legislative enactments have prudently regulated and restricted its sale by druggists and others, with a view to protect mankind, as far as may be, from the evil effects of its indiscriminate distribution.

In contrast with this general knowledge of the poisonous properties of arsenic, and with the carefully devised measures which are enforced in order that the least possible harm may result from the employment of such an agent, is its unrestricted use in certain arts, and in the manufacture of certain articles which, by most persons, are deemed harmless. The application of arsenic as an ingredient in certain pigments is very extended. It finds its way thus into our dwellings is spread on the walls of sleeping rooms, is worn in articles of dress, and assumes a great number of forms in which its presence is unsuspected, or, if recognised, is not deemed deleterious. It is the object of this paper to point out some of these forms in which arsenic is introduced to daily use, and to inquire if this liberal exposure is productive of harmful results.

The investigation is not an original one. At various intervals during the whole of the present century, attention has been called to the subject by scientific observers; strong warnings have been given of the danger which was believed to be entailed, and earnest appeals made for some effective legal measures of restriction or of prohibition. So long ago as 1740, the employment of arsenic as a pigment in certain manufactures was forbidden in France, and attempts have been made from time to time since then to regulate trade in this respect. These warnings and enactments have, however, proved but partially effectual; and it is believed that at the present day the subject is one which warrants solicitude in behalf of the public health, and justifies renewed investigation by its continued magnitude.

Arsenic, aside from its utility as a remedial agent, is chiefly employed to form an ingredient of certain green colouring matters. It enters into two of these pigments —the arsenite of copper, which is Scheele's green, and the aceto-arsenite of copper, called also Schweinfürt green, from the town where it is largely manufactured. To both of these names are, moreover, given interchangeably, and they are generally known among workmen as emerald green or "emerald," mineral green, sometimes (although erroneously) as Brunswick green or Vienna green. In France, they are called *vert Anglais*, or English green. Of these colours, the former (Scheele's green) contains more than one-half its weight (55 per cent) of pure arsenious acid, or white arsenic; while the Schweinfürt green is still more abundantly supplied, having, in 100 grains, 58 grains of the poison.

Either of these combinations of arsenious acid and sulphate of copper forms a very beautiful and durable green colour whose brilliancy will bear any light well. Its tint is a lighter and purer green than any other of artificial manufacture, and hence is especially alluring to the eye. The materials of which the pigments are made are comparatively inexpensive, and the manufacture involves very little intricacy or delicacy in its various processes. For these reasons, these arsenical greens have always maintained their popular favour, both with manufacturers and the public in general. Their use has been, and still continues to be, extensive and lucrative, giving employment to large numbers of workmen. So important has their application been considered in the making of wall-paper and of artificial flowers in Paris, that when, at one time, it was agitated whether it were practicable to prohibit the use of arsenic in these arts, certain of the manufacturers protested that such an edict would necessitate the absolute suspension of their works. In 1860, a manufacturer of paper-hangings in England stated that he used 2 tons of arsenic weekly;* and the amount of the colour annually manufactured in England was estimated in 1862 at from 500 to 700 tons.†

It should not be inferred from these statements that all green pigments in ordinary use are arsenical. Not a small proportion of the green colours employed for painting, dyeing, or colour printing are of other and comparatively harmless composition. It is not always easy to distinguish them by their physical appearances, but chemistry affords a ready test which may be easily applied. The suspected green material is to be placed in a solution of ammonia. If arsenite of copper be the colouring agent, the liquid will acquire a blue tint, owing to the disengagement of the oxide of copper from its combination with the arsenic. If a further test be desired, a few drops of the coloured ammoniacal solution poured upon crystals of nitrate of silver will leave on the crystals a deposit of yellow arsenite of silver.

These arsenical green pigments are both deadly poisons, differing in the intensity of their effects only in slight degree from the pure arsenic of which they are in part composed. Taken into the stomach, they give rise to the same train of symptoms and demand the same prompt antidotes. The combination of the arsenious acid with

* From the "Third Annual Report of the State Board of Health of Massachusetts."

* Taylor, "On Poisons," p. 430.
† "Fifth Report of Medical Officer of Privy Council," 1863, p. 129.

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copper serves only to dilute the poisonous properties of the former, and offers no farther protection against its action. Suicides have availed themselves of the pigment as a means of self-destruction. In 1849, a girl, aged 12 years, a maker of artificial flowers, became possessed with a distaste of life remarkable at her age. She swallowed a quantity of the arsenical green powder used in her work; symptoms of acute arsenical poisoning promptly supervened, and in spite of remedies, vigorously applied, the girl died in a few hours.

Such are the properties of the green colouring matters containing arsenic. It remains to study some of the forms under which they are presented to the public, with the dangers pertaining to their indiscriminate employment.

I. *Artificial Flowers and other Articles of Dress.*—The manufacture of artificial flowers constitutes an important and extensive industry both in this country and abroad; and into some of its various branches the employment of the arsenical greens has largely entered. Many of the green sprays of artificial grass and leaves which so closely imitate the verdure of nature and bring out in artistic contrast the floral colours with which they are combined, owe their delicate shade and brilliancy to the presence of emerald green.

The process of manufacture is a simple one. Generally, the texture from which the leaves are to be cut is coloured in the piece. The colouring material is made by thoroughly stirring together a mixture containing, in definite proportions, the green pigment, cold water, and starch, gum-arabic, or some similar substance which shall give the colour consistence and adhesiveness. Not unfrequently, in this process, the hand and fore-arm are freely used in the liquid, to expedite the work. Of this mixture, properly prepared, the workman takes a quantity in his fingers, and roughly spreads it over the muslin or fine calico. The fabric is then beaten and kneaded between the hands until it is uniformly coloured; the longer this process is continued the more perfect is the result. The cloth is now fastened to a frame for drying. In all this process of colouring, the hands, fore-arms, and frequently also the face of the operative must become soiled with the green colour. It will be also observed that the colour is but loosely applied, no mordant being used, as in calico-printing, to fix the pigment in the texture of the cloth.

In the various subsequent processes of cutting, stamping, shading, and mounting, to which the material must be subjected before the plain cloth becomes the artificial leaf, the arsenical green which is used to produce such a close resemblance to natural verdure inevitably escapes in greater or less abundance, and mingles with the ordinary dust of the apartments in which the manufacture is carried on. Moreover, some of the special methods which are employed to perfect the work promote the dissemination of the powder: thus, in the operation called "fluffing," which consists in dipping the leaf into warm wax and immediately dusting the dry colour upon it from a dredging-box, the workman is particularly exposed to the effects of the freely-floating particles. All the manipulations, in short, subject the material to varying degrees of violence, by which the arsenical powder is detached. This powder is inhaled by those exposed, and the precaution sometimes employed of placing towels or other masks before the mouth and nostrils cannot furnish absolute protection to the wearers. The moist skin attracts the dust, and the clothes give it lodgment. The soiled hands are not often perfectly cleansed before they are used to convey food to the mouth, and an additional source of risk is thus provided.

The quantity of arsenic which, in the various processes of their manufacture, these artificial leaves are sometimes made to take up would appear almost incredible. Careful chemical analysis has determined this amount repeatedly. Hofmann found, in a single twig of twelve leaves, 10 grains of pure arsenic. A lady might thus carry, in all innocence, to an evening party enough arsenic in her floral adornments to destroy herself and a score of her fellow guests.

The effects which exposure to the arsenic contained in artificial leaves may produce, either in those engaged in their manufacture or in those who use them, have been renewedly made the subject of careful investigation. Intelligent and impartial scientific observers in France, Germany, and England do not hesitate in declaring the pernicious influence of continued exposure to such conditions, and numerous instances are cited to demonstrate not only harmful, but occasionally fatal effects. An investigation was made by M. Vernois, in 1859, concerning the accidents resulting among the flower makers of Paris from the use of arsenical greens, and, as the result of his researches, he points out many symptoms which, he believes, may be directly traced to arsenical infection. Among these are included various eruptions on the skin, presenting sometimes a papular form, sometimes vesicular, sometimes a simple diffused redness (erythematous), and sometimes developing to ulceration and gangrene, the seat of the disease being preferably those parts exposed most directly to the irritant action of the poison, as, for example, the hands and face, the former especially presenting ulcerations if the colour enters cuts or abrasions. Along with these external symptoms are loss of appetite, nausea, colic, continued headache, pallor, and debility.* Dr. Hassall, writing in England at about the same period, in describing one of his visits to a manufactory of artificial flowers in London, states:—

"In the same room were two men, eight women, and two boys, the condition of all being wretched in the extreme. They were all similarly affected. They all had sores; the girls, at the back of the neck, on the sides of the nose, and on the hands; their eyes were also affected, and there was running from the nose. To such an extent was their health affected that they were obliged from time to time to give up their work and return home."†

Dr. Hillier, too, investigated the condition of the London flower-makers in 1861, and found that they "suffered from chronic inflammation of the stomach and bowels, irritation of the eyes, great nervous debility and prostration, with local irritation of the skin of the hands, neck, and scalp when the powder was brought into contact with, and allowed to remain on, those parts." Several workpeople stated that they were constantly ill while working with this powder."‡

But besides these generally acknowledged symptoms of chronic arsenical poisoning, as manifested in these people after working continuously with emerald green, still more serious results are possible, and cases are recorded of fatal effects upon specially susceptible organisms. The following is illustrative:—In 1861, a girl, aged nineteen years, who had been engaged continuously during eighteen months in making artificial flowers with emerald green, died in London with all the characteristic symptoms of chronic poisoning by arsenic. Her sufferings were very greatly intensified towards the close of life. Examination after death discovered the very evident presence of arsenic in the internal organs.‖

These exceptionally fatal cases bear very small proportion, it is true, to the numerous well authenticated instances of less serious results which are notorious among the operatives themselves as arising in their vocation. This is explained partially by the fact that such fatalities might readily be ascribed to other causes, supposing them to occur more frequently, while, on the other hand, it is obvious that persons exposed to such a noxious influence would probably desist from this work long before the symptoms were serious enough to threaten a fatal termination.

But not only do the operatives, who in making the

* *Annales d'Hygiène*, 2nd ser., tome xii., p. 329.
† *Lancet*, 1860, p. 535.
‡ "Fifth Report of Medical Officer of Privy Council," 1862, p. 126.
‖ *Medical Times and Gazette*, Nov. 30, 1861.

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artificial flowers use the arsenical greens, suffer in proportion to their susceptibility and exposure, but in many cases also those who wear them, and those who, like shopkeepers and milliners, habitually handle them. A case is reported of a clerk who always had vertigo, headache, nausea, and cough whenever he opened and handled new packages of green artificial foliage.* In another instance which is recorded, a lady's shoulders became the seat of a painful eruption directly after each occasion of wearing a wreath of artificial flowers and leaves at evening receptions; and, in two other reported cases, an erysipelatous eruption on the forehead was traced to a similar cause.† The physicians to some of the large London hospitals have expressed themselves as familiar with "the inflamed eyes and disfiguring eruptions," which, as they assert, result from the use of the arseniferous verdure.

It is obvious that of such cases only the most remarkable and clearly defined would be reported; and we may reasonably infer from these that many less distinctive instances really occur. It is not unreasonable to suppose, for example, that the health of milliners, proverbially delicate as a general thing, may depend for its deterioration to some extent upon this factor, as well as upon overwork, crowded and ill-ventilated rooms, and insufficient exercise. It is bad enough to inspire an ordinarily foul atmosphere, but it can certainly add nothing to atmospheric purity to mingle with the dust of a room any proportion, however small, of oxide of copper or of white arsenic.

Closely related to the foregoing topic, is the use of the arsenical green pigment in the manufacture of other articles of dress; and among these the material called tarlatane, a light fabric resembling muslin, has attracted much attention. The mineral green with which the material is coloured recommends itself because of the brilliancy of its shade and of its permanency by artificial light; and the fabric has therefore at times been quite fashionable. A considerable quantity of it is still sold for dresses, or for the trimmings used by milliners. It is known popularly as an "arsenical" green, so that its character is not altogether unrecognised.

In the manufacture of this material, the colour is fixed only by starch or size, and when tarlatane is torn, a plentiful cloud of light green arsenical dust arises. The slightest agitation also serves to disengage the coloured powder, and to diffuse it through the adjacent air. It is easy to discover how readily the wearer of one of the expansive dresses prescribed by fashion might under certain circumstances surround herself with a cloud of poisonous dust of whose effects on herself and on those about her she would be unhappily ignorant.

The arsenical-green tarlatanes contain nearly half their weight of colouring matter. A sample, procured by the writer in one of the retail stores of Boston, was analysed quantitatively by Prof. William Ripley Nichols at the Massachusetts Institute of Technology, and found to contain 8·21 grains of arsenious acid (white arsenic) to each square foot. A dress of ordinary dimensions would thus hold feebly in its texture between three and four ozs. of pure arsenic.

It would not seem probable that the occasional wearing of such a material would produce symptoms of serious harm to either the wearer or to those around her, the noxious exposure in such cases being limited in time and degree. Yet instances are not wanting to demonstrate its deleterious effects on those engaged in making the fabric into dresses. In one case, reported by Chevallier, five dressmakers were more or less seriously affected after working on the tissue.‡ Two years ago a similar instance of poisoning occurred in France, where arsenical greens are prohibited by law; and the dress was found to contain nearly eight ozs. of arsenic.* On one occasion, where a new ballet was performed at Hamburg, the dancers who represented water nymphs, were dressed in green tarlatane. These dresses "nearly cost the lives" of those who made them, and of those also who wore them. So large was the quantity of arsenic in the fabric that nearly all were more or less poisoned.†

In 1869 a case of poisoning from the cause under consideration occurred in Boston, the details of which were given to the writer by one of the persons affected. Four dressmakers, while engaged upon some party dresses of which the material was arsenical green tarlatane, became simultaneously affected with well-marked symptoms. These symptoms consisted of swelling of the hands and face, a "pimply" eruption on the back of the hands and about the nostrils, running from the nose, and free lachrymation. With these local effects were headache, lassitude, and a feeling of general illness. The attack coming on in the midst of perfect health, and affecting all but one of those who worked upon the arsenical fabric, left little doubt in the minds of the sufferers of the nature of the poison. The symptoms subsided as soon as the exposure ceased.

(To be continued).

* *Dublin Quart. Journ.*, vol. xxxii., p. 234.
† *Ibid., loc. cit.*
‡ *Annales d'Hygiene.* xii., p. 99.

† CHEMICAL NEWS, Sept. 10, 1869.
‡ *Medical Times and Gazette*, April 11, 1863.

ON DYES AND DYE-STUFFS OTHER THAN ANILINE.‡

By Dr. F. CRACE CALVERT, F.R.S.

(Continued from p. 20).

‡ The Cantor Lectures, delivered before the Society of Arts. Revised and communicated by the Author.

Red Colouring Substances (continued):—*Munjeet; Campechy, Peach, Sappan, Cam, and Bar Woods; Alkanet Root; Safflower; Cochineal, Lac-Dye; Murexide.*

Munjeet.—It is to the researches of Dr. John Stenhouse, one of the most eminent and learned of English chemists, that we are indebted for our knowledge of the true composition of many of the dye-stuffs, and it is to him that we are indebted for the whole of the information we possess in the colouring matters of munjeet, or *Rubia Munjista.*

This peculiar variety of the genus *Rubia* is cultivated exclusively in Asia, and especially in India, where it has been used as a dye-stuff for a long period of time, either alone or mixed with other dyes, to produce a variety of red shades. It is imported into this country from time to time, but has never been extensively used, as the colours produced from it are neither so fast nor so bright as those obtained with *Rubia tinctorum.*

Whilst the colouring principles of madder are purpurine and alizarine, those of munjeet are purpurine and a yellow colouring matter, named by Dr. Stenhouse munjistine. He has assigned to this latter body the formula $C_{16}H_8O_6$. When crystallised from an alcoholic solution, it forms large, beautiful, golden-coloured flakes, which sublimed, give prismatic crystals, of an orange-red colour. It is only slightly soluble in cold water, but freely soluble in hot water. Its best solvent is bisulphuret of carbon, which was employed with success by Dr. Stenhouse in separating the purpurine and munjistine from the other substances existing in munjeet. He states that the munjeet root contains as much colouring matter as the *Rubia tinctorum*, and, according to Mr. Higgins, of Manchester, it yields from 52 to 55 per cent of a garancine; but as it has only half the dyeing power of ordinary garancine, it cannot be employed with advantage for this purpose. The inferiority of munjeet arises from its containing only the comparatively feeble colouring matters, purpurine and munjistine. Munjeet is not much used by calico-printers,

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as the munjistine gives a brownish-purple with salts of iron, which prevents it being employed with that mordant. It is used for special shades of Turkey-red, the munjistine giving, with salts of alumina, an orange-yellow colour, which is in some instances employed by the dyers.

I have now the pleasure of calling your attention to an important class of dyeing substances, "the dye-woods."

Campechy or Logwood.—This wood, obtained from a large tree of the leguminous family, called by the botanist *Hematoxylon campechianum*, grows abundantly in the West Indies, Mexico, and other states of South America. The best quality is imported from the Bay of Campechy, in the Gulf of Mexico. Large quantities are also obtained from Jamaica and St. Domingo. The qualities obtained from Honduras, Martinique, and Guadaloupe are inferior.

Campechy was introduced into Europe by the Spaniards, but it was not till the reign of Elizabeth that it came into use in England, and then only for a short period, after which its employment was forbidden under the severest penalties for upwards of a century.

The discovery of its colouring principle, hematine, was made in 1810, by my learned and venerable master, M. Chevreul (who, although now 85 years old, is still actively engaged in scientific pursuits). Shortly afterwards it was studied by Ermann, who gave it the name of hematoxyline. It was obtained by these eminent chemists as yellowish white prismatic crystals, which become discoloured by contact with the oxygen of the air and the small amount of ammonia which the atmosphere contains. It is only slightly soluble in cold water, but much more so in hot. It is very soluble in alcohol, ether, and bisulphuret of carbon. It combines with three equivalents of water, forming a crystalline hydrate, which at 212° F. retains one equivalent.

Hematine in the presence of oxygen, especially under the influence of alkalies, assumes a beautiful purple colour. This colouring matter can be obtained under the form of purple-black crystals, having a metallic lustre, and has received the name of hematëine. Hematine has the formula $C_{16}H_{14}O_6$, which, on conversion into hematëine, becomes $C_{16}H_{12}O_6,H_2O$. The hydrate is $C_{16}H_{14}O_6,3H_2O$, which at 212° F. becomes $C_{16}H_{14}O_6,H_2O$.

The oxidation, and consequent colouration, of hematine under the influence of oxygen and alkalies is so rapid that it may be used as a most delicate test of the presence of carbonate of lime in natural waters; and it is a fact well known to practical dyers that waters containing a large quantity of carbonate of lime are well adapted for the production of good logwood blacks. Hematine gives little or no colouration with salts of protoxide of iron, but hematëine gives a dark purplish blue; the latter also gives dark blue precipitates, with salts of lead and tin. Hematëine is easily reduced to hematine by hydrogen and sulphuretted hydrogen.

In my opinion, the colouring matter in *Hematoxylon campechianum* exists in the state of a glucoside, for when the trees are felled the wood is colourless; but by the time the logs arrive here the outside is of a dark red colour, whilst the inside has only become of a pale yellow colour.

As hematëine is the principle which the dyer requires, the logs are ground into a coarse powder, which is moistened and laid in beds 15 or 20 feet long by 10 or 12 broad, and about 3 feet thick. A slow fermentation ensues, by which the glucoside is decomposed and the hematine liberated. It is converted into hematëine by stirring the mass, thus exposing it to the oxygen of the air, the action being quickened by the ammonia of the atmosphere as well as by that given off by the decomposition of the azotised principles existing in the wood.

This prepared wood is used by the dyer to produce logwood blacks, as I shall describe further on, and also by wood extract manufacturers, who prepare an extract which is much used in calico-printing. To prepare this extract it is necessary that the wood should not be too highly oxidise and that the solution obtained from it by successive a repeated lixiviation should be slowly concentrated at comparatively low temperature, that is to say, not e ceeding 150° F.; for if a high temperature be employ the hematëine is still further oxidised, and a dark pur resinous principle produced, which spoils the brilliancy the colour.

This extract is chiefly used in print works, to produ purples in steam styles.* A strong logwood solution thickened with starch, and printed on a prepared clot that is, a cloth that has been passed through a soluti of stannate of soda, then through weak vitriol, by whi means the binoxide of tin has been fixed as a mordant the fibre of the cloth; the fabric after washing and dryin is ready for the printer. After being printed, the clo is either rolled on a perforated cylinder or hung in iron chamber, and submitted to the action of steam, whe the hematëine combines with the oxide of tin, producin a beautiful purple.

If blacks are to be produced, an iron mordant is fix on the fabric, which is then passed through a logwoo solution. It is afterwards washed, and the black full developed by passing it through a hot dilute solution bichromate of potash.

Logwood and its extract are much used in Yorkshi for producing cheap blacks on mixed fabrics, which a goods in which the warp is cotton and the weft woolle The black is produced by dyeing the fabric in a ba composed of logwood, sulphate of soda, and bichroma of potash.

It is often very useful to distinguish logwood blac from sumach and other fast blacks, and logwood purpl from aniline purples. This is easily effected by submi ting the piece to the action of weak acids; the logwo colours assume a bright red tint, while the others rema unchanged.

Brazil Wood.—We shall now pass on to a series woods which are all obtained from the genus *Cæsalpini* belonging to the natural order *Leguminoæ*.

Although these woods have long been employed dyes by the natives of the countries where they gro it is only since the introduction of Brazil wood by t Spaniards, that their value as dye-stuffs has been know in Europe. The best qualities are all imported fro Brazil. The particular wood known as Brazil woo derived from the *Cæsalpinia brasiliensis*, has becom scarce in the market, from its having been all cut in t districts within easy distance of shipping ports.

The wood most in favour at the present day com from Pernambuco, and is the *Cæsalpinia Crista*. Th tree is also found in Jamaica. That obtained from Sier Nevada is not of such good quality.

Another variety, bearing the name of peach-wood, chiefly derived from Nicaragua. A third, known Sappan-wood, comes principally from Siam, the Ea Indies, and other eastern countries. A rather inferi quality, known as Lima-wood, is imported from Peru.

All these woods appear to contain the same glucosi and, like the previous ones, are decomposed by peculi ferments, into a saccharine matter and a colour-givi principle. This is proved by the following experimen If the decoction obtained by treating the wood from t interior of the sticks be boiled with a solution of doub tartrate of potash and copper (the best known test f grape sugar), no precipitate is obtained; while if t glucoside be first decomposed by boiling with a dilu solution of hydrochloric or sulphuric acid, and aft wards treated with the copper salt, an abundant pre pitate of suboxide is thrown down. The decoctic

* Calico printers employ the word style or goveis when speaking a class of goods which are denoted by a word characterising the colo ing matter used, or the method employed in producing them. Mi der goods and garancine styles may be given as examples of the fi and steam styles of the second.

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which has only a faint yellow colour, gives a most abundant and brilliant precipitate with subacetate of lead. The colour-giving principle was discovered by M. Chevreul, who gave it the name of *braziline*. By oxidation it is converted into *brazilëine*. It also combines with water, to form a hydrate containing two equivalents of water. Professor Bolley gives the formula of braziline as $C_{22}H_{20}O_7$, and that of the hydrate $C_{22}H_{20}O_7 2H_2O$. He has also made the curious observation that a comparison of the formulæ of hematine and braziline shows a difference equal to carbolic acid, as may be seen by the following table:—

Braziline	$C_{22}\ H_{20}\ O_7$
Hematine	$C_{16}\ H_{14}\ O_6$
Difference ..	$C_6\ H_6\ O_1$ Carbolic acid.

What is still more remarkable is, that by the action of nitric acid upon hematine, he obtained oxalic acid, whilst under similar circumstances braziline yields oxalic acid and picric or trinitrophenic acid, which is the product obtained when carbolic acid is acted upon by nitric acid.

A decoction of any of these woods becomes yellow or orange, (according to the quantity of braziline or brazilëine it contains) on the addition of an acid, and by the addition of an alkali, a beautiful crimson red, the shade of which varies according to the proportion of the two principles. It also becomes red with bichromate of potash, and gives a red precipitate with oxymuriate of tin.

These characters are sufficient to distinguish between a solution of these woods and one of logwood.

To prepare a good commercial extract from these woods, they must be finely ground, as they yield their colour to water with difficulty; like logwood, they must be allowed to ferment and oxidise in the air, but not to the same extent. The concentration of the decoctions differs from that of logwood in the fact that they can bear a higher temperature. The more quickly they are evaporated the brighter are the colours which the extract gives. Dr. Dingler has proposed a process which is stated to give very good results. It consists in adding 4lbs. of gelatine, dissolved in water, to every cubic yard of ground wood, and allowing the whole to ferment for several days. The wood so treated yields a stronger and richer extract than that obtained by the ordinary process; no doubt the gelatine helps the decomposition of the glucoside, and the ammonia produced facilitates the oxidation of the braziline. By the addition of a small quantity of chlorate of potash to the hot extract, Mr. Peak greatly increased its brilliancy, and rendered it more valuable to the printer on account of the brighter colour produced on the fabric.

These extracts are principally used to obtain pinks and reds in steam styles. To effect this, acetate of alumina, chloride of tin, oxalic acid, or acetate of copper is added to the extract, and printed on the prepared cloth already described, which is then submitted to the action of steam.

These woods are also used in conjunction with a little fustic, or bark, in the production of cheap garancine styles. These inferior garancine prints are easily distinguished from the good ones by means of a hot soap-bath, which only slightly affects the good, while the inferior are almost entirely destroyed. The woods also are sometimes used for the adulteration of garancine.

I may state, before leaving this subject, that the decoction of these woods yield very beautiful pink lakes, which are principally used by paper-stainers.

Common red ink is also prepared by adding a little alum and acid to an aqueous solution of these woods.

Red Sandal, Cam, and Bar Woods.—The next class of dye-stuffs which we shall have the pleasure of studying together are derived from several varieties of the genus *Pterocarpus*, which are indigenous to the tropical parts of both the new and the old world. It is principally from the East Indies, Ceylon, Madagascar, and the coast of Malabar, that santal, sandal, or red sanders-wood is imported, whilst cam and bar woods are procured from the West Coast of Africa.

The colour-giving principle of this class of plants is only developed with age, the young branches not containing any, whilst it is found in large quantites in the trunk. Professor Bolley proved that it is the same colour-giving principle which exists in each variety, and he gave it the name of santaline. MM. Wagermann and Haeffely consider that it has the formula $C_{15}H_{14}O_5$. It is a bright red crystalline powder, insoluble in water, but soluble in alcohol, ether, and acetic acid. The latter solvent yields the colouring matter to albumen, which is an important fact, and may one day be rendered practically useful. Santaline is freely soluble in alkalies, giving a violet-red solution, from which acids precipitate the colouring matter.

Red sandal-wood is chiefly used on the Continent, where it is employed to give a bottom* to cloth which is to be afterwards dyed with indigo. By this process a very fine blue is produced, having a purple hue by reflected light.

Cam-wood, and especially bar-wood, is chiefly used in England for producing on cotton yarns brilliant orange-red colours, known as mock Turkey-reds. They are, however, neither so fast nor so bright as the real Turkey-red produced from madder, and are easily distinguished from it by yielding their colour to a hot soap solution, or to alkalies.

(To be continued.)

A NEW METHOD OF OBTAINING POTASSIUM.

By Prof. A. E. DOLBEAR.

PERHAPS it is not possible to discover a process for obtaining the metals potassium and sodium better than the one usually employed with the carbonates of the metals and charcoal, heated in iron retorts, but it is a very desirable thing to obtain them cheaply on account of their use in the manufacture of aluminum. As I have been successful in obtaining potassium by a method new to me, the process may have some interest to chemists, whatever may be its commercial value.

Some white stick caustic potash of commerce was dissolved in water and then treated with sulphuretted hydrogen in the way commonly described for making potassium sulphide, K_2S. The solution was evaporated until it was solid when cool, when the yellowish mass was mixed with more than its bulk of iron filings and chips, and the whole put into an alembic for distillation. The heat of a furnace was applied till the alembic was of a bright red heat, and the products of distillation were received in common coal oil. The product was rather small, as some of the potassium vapour decomposed the heated vessel; nevertheless the potassium showed itself when the oil was poured off, and the residuum turned upon water by its characteristic ignition and flame. The reaction is simple and may be thus represented. $K_2S+Fe=FeS+K_2$.

I have not conveniences for experimenting upon this on a scale large enough to test its comparative value; it needs some special arrangements of protected vessels, as it violently attacks common crucibles, porcelain, and glass. The materials used for thus obtaining it are of the required cheapness, and the iron sulphide product can again be used to furnish sulphuretted hydrogen for another quantity.

It is probable that sodium can be obtained by an analogous process, but I have not attempted it.—*American Chemist.*

* This term is used in dyeing, to denote that a colour is applied to a fabric with a view of giving a peculiar hue to a dye which is applied after it.

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NOTICES OF BOOKS.

A Manual of Chemical Physiology, including its Points of Contact with Pathology. By J. L. W. Thudichum, M.D. London: Longmans and Co. 1872.

To the student in Chemistry and other Sciences Dr. Thudichum's work offers a ready help to the acquisition of elementary knowledge, upon which can be afterwards placed the superstructure of more detailed studies. The manual is divided into two parts, the first having been written as the introduction to the Author's "Researches intended to Promote an Improved Chemical Identification of Diseases," published in several numbers of the annual "Report of the Medical Officer of the Privy Council," and being a concise epitome of physiological or animal chemistry. The second part of the work is an Analytical Guide for the use of Students who desire to become practically acquainted with the constituents of animal bodies. The manual is well illustrated with drawings of spectra; is clearly arranged, and contains more than the usual amount of information, supplying a want amongst medical students.

A New Star Atlas, for the Library, the School, and the Observatory. By Richard A. Proctor, B.A. (Camb.), F.R.A.S., Author of "The Sun," "Other Worlds than Ours," "Saturn and its System," &c. London: Longmans, Green, and Co. 1872.

This admirable little Atlas is a reduction from Mr. Proctor's large Star Atlas, and is intended as a companion to Webb's "Celestial Objects for Common Telescopes." It fulfils a crying want, for we have had hitherto no work directing the student of the heavens to its chief star groups. But this little work is so well arranged, that it includes besides the chief features of the heavens, groups that are unattempted in much more pretentious works. It will well repay packing in the trunk and studying on some starry night during the country vacation tour.

Lecture Notes for Chemical Students. By Edward Frankland, D.C.L., F.R.S., Corresponding Member of the Imperial Institute of France, &c., Professor of Chemistry in the Royal School of Mines. Vol. II. Organic Chemistry. Second Edition. London: Van Voorst. 1872.

Students of chemistry under the auspices of Dr. Frankland will be glad to learn that a second edition of the "Organic Chemistry" has been published with the additions required by the advancement of synthetical investigation.

Chimie Organique Elementaire. Lecons Professées a la Faculté de Mêdecine. Par Edouard Grimaux, Professeur agrégé à la Faculté de Mêdecine de Paris. Paris: Baillière. 1872.

We are indebted to our French neighbours, and to Dr. Atkinson for one of the best text-books of physical science, and doubtless we shall soon have a translation of this admirable little work from the pen and laboratory of Professor Grimaux, for a better ordered or more complete treatise it would be difficult to find. Written for medical students, the work has not that want of experimental data so common in works on medical chemistry. The modes of preparing the principal organic compounds are fully detailed, their composition considered, and their physiological action explained, while to the latter no undue prominence is given. The work is thus as useful, and perhaps more interesting to the general student of chemistry than the average hand-book, dealing with theory or practice apart; while the information as to the toxic effects of the several substances is not only a valuable but a necessary adjunct. We commend the work, and we cannot do so too highly.

CORRESPONDENCE.

PROPOSED ASSOCIATION OF MANUFACTURING CHEMISTS.

To the Editor of the Chemical News.

Sir,—I have read all the correspondence in your journal as to the organisation of an Association of Manufacturing Chemists, and highly approve of it. No doubt there are many departments of our great staple industry where the varying experience might lead to general benefit without interfering with the specialities of different manufacturers; and the communication of ideas would, as in other important manufactures, lead to improvements that would benefit all. I shall be most happy to afford my small aid to such an institution in any way practicable.—I am, &c.,

Peter Spence.

Pendleton Alum Works, Manchester,
July 15, 1872.

To the Editor of the Chemical News.

Sir,—The want of an Association of Chemical Manufacturers is one that I have long felt, as there are many questions affecting the trade that can only be properly ventilated by such a society; among others, I would mention the questions of sampling and chemical analysis. I shall be most glad to forward the scheme in any way, and would suggest that there should be a committee formed who would endeavour to put the matter into a working form. I am convinced that all the principal firms would most gladly co-operate.—I am, &c.,

Edward Purser, Jun.

Plough Wharf, Cubitt Town,
July 15, 1872.

MISCELLANEOUS.

Society of Arts.—Technological Examinations.—His Royal Highness Prince Arthur will preside at a conference on this subject, to be held at the rooms of the Society, in the Adelphi, on Saturday, July 20th, at 12 o'clock. Merchants, manufacturers, and others interested in the movement, are invited to attend.

Quality of Metropolitan Gas.—Dr. Letheby, the chief Gas Examiner appointed by the Board of Trade, has recently reported to the Corporation of the City, and to the Metropolitan Board of Works, on the quality of the gas supplied to the Metropolis by the Chartered, the Imperial, and the South Metropolitan Gas Companies, during the last three months; from which it appears that the illuminating power has never been less than that required by the Acts of Parliament. The common gas of the Chartered Company has ranged from an average power of 16·89 standard sperm candles at the Millbank testing-place, to 17·85 candles at the testing-place at Mile End. The Imperial Company's gas has ranged from 15·78 candles at Camden Street, to 16·85 at Oakley Square, Chelsea; and the gas of the South Metropolitan Company has averaged 15·78 candles. The cannel gas of the Chartered Company has had an average illuminating power of 25·74 candles at Millbank Street, and 26·08 candles at Arundel Street in the Haymarket. With respect to purity, Dr. Letheby reports that the gas at each of the testing-places has been constantly free from sulphuretted hydrogen, but that the fluctuation in the amounts of sulphur have been considerable, as from a miminum of 2·2 grains per 100 cubic feet of gas at Mile End, to a maximum of over 40 grains at Beckton, at Cannon Street, at Arundel Street, and at Hill Street Peckham; the average proportions at the different testing-places having been as follows:—The common gas of the Chartered Company at Beckton 26·98 grains per 10

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cubic feet; at Cannon Street 25·77 grains; at Friendly Place, Mile End, 8·71 grains; at Arundel Street, Haymarket, 18·89 grains; and at Millbank Street, Westminster, 26·96 grains; while that of the Imperial Company has been 32·98 grains at Oakley Square, Chelsea; 28·16 grains at Camden Street, Camden Town; and 25·71 grains at Graham Street, Dalston. The average amount of sulphur in the South Metropolitan gas was 36·05 grains per 100 cubic feet. It is a noticeable fact that the quantity of sulphur in the gas of the Chartered Company at Friendly Place has only once contained as much as 20 grains per 100 feet; and that during the last month the gas at Beckton, at Cannon Street, at Friendly Place, and at Arundel Street, has never contained 20 grains per 100 feet; the average for the month having been from 4·63 grains at Friendly Place to 13·64 grains at Beckton. Dr. Letheby regards this as highly satisfactory. The proportion of ammonia in the gas has not at any time or place exceeded the quantity (2·5 grains per 100 cubic feet) prescribed by the referees; the average amount being from nil to 1·28 grains per 100 feet.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, June 24, 1872.

This number contains the following original papers and memoirs relating to chemistry:—

Examination of the Rocks containing Native Iron which were Discovered in Greenland in 1870 by Dr. Nordenskjöld.—M. Daubrée.—This extensive essay treats on the lithology of the large meteorites found in Greenland and transferred to Europe last year. The percentical composition of the blackish coloured metallic rock of Ovifak is stated by the author to be as follows:—Metallic iron in free state, 40·94; iron combined with oxygen, sulphur, and phosphorus, 3·15; combined carbon, 3·0; free carbon, 1·64; nickel, 2·65; cobalt, 0·91; sulphur in the state of sulphuret, 2·70; arsenic, 0·41; phosphorus, 0·21; silicium, 0·075; nitrogen, 0·004; oxygen, 12·10; constitutional water, 1·95; hygrometric water, 0·91; sulphate of lime, 1·288; chloride of calcium, 0·039; chloride of iron, 0·027; chromium and copper, 1·01. The author describes at length his method of analysis, and devotes several pages to the discussion of the following points:—Comparison of this rock with meteoric stones and with other rocks met with on our globe; conditions of formation of the Ovifak and other carbon-containing meteorites, and their synthetic imitation.

Solution of Carbonate of Lime by Carbonic Acid.—Th. Schlæsing.—This memoir contains a lengthy account of a series of experiments made with the view to elucidate the action of carbonic acid present in arable soil, from which the following conclusions are drawn:—When carbonate of lime, in excess, is placed in an atmosphere containing a constant proportion of carbonic acid, water simultaneously dissolves free carbonic acid, neutral carbonate, and bicarbonate of lime. The carbonic acid is dissolved according to the well-known proportions, and as if the water contained no carbonate of lime; the solution of neutral carbonate takes place as if in pure water free from carbonic acid: as regards the solution of bicarbonate of lime, its proportion depends, for a given temperature, on the tension of the carbonic acid gas contained in the gaseous mixture experimented with.

Industrial Preparation of Aniline Colours.—MM. Girard and De Laire.—Reserved for full translation.

Newly-contrived Galvanic Element, more particularly Arranged for Therapeutical Purposes, and to be Used with Sulphate of Copper.—J. Morin.—The description of an apparatus which is an improved modification of Daniel's galvanic element, yielding a very regular and continuous current.

Some Paraffin Compounds.—P. Champion.—By the prolonged action, aided by heat, of nitrosulphuric acid upon paraffin (the variety prepared from bogbead mineral fusing at 53°), the author has obtained paraffinic acid, a fluid which does not solidify at −10°; sp. gr. at 15°=1·14; it is insoluble in water, but soluble in ether, alcohol, wood-spirit, and amylic alcohol; its reaction is acid; it burns with a luminous flame; it is soluble in and forms compounds with ammonia, soda, and potassa; formula, $C_{26}H_{26}NO_{10}$. Its composition in 100 parts is—Carbon, 56·53; hydrogen, 9·42; nitrogen, 5·07; oxygen, 28·98. The soda salt of this acid is soluble in water, but the baryta and silver salts are insoluble in that fluid. The ethylic salt of the paraffinic acid is a solid body, soluble in alcohol and ether; formula, $C_{26}H_{25}(C_4H_5)NO_{10}$. The properties of the methylic and amylic salts of this acid agree with the ethylic salt. By causing nitrosulphuric acid to act for ten days upon paraffin, a compound, $C_{25}H_{23}NO_{12}$, is obtained. Paraffin is readily and rapidly acted upon by fuming nitric acid at 110° under pressure. The action of chlorine, bromine, and iodine upon paraffin is briefly alluded to; the two first-named haloids appear to form compounds with paraffin, but, even at 200°, iodine scarcely acts upon paraffin.

Among the large number of memoirs and papers contained in this number, and bearing upon natural history and other sciences, we call attention to the following essay:—

Dr. Liebreich's Experiments made to Prove that Strychnia is the Antidote of Chloral.—M. Oré.

Gazzetta Chimica Italiana, No. 4, 1872.

The following is the only original paper contained in this number:—

On Chloropicrin.—A. Cossa.—The author first describes, at great length, the rather complicated method of preparation of the body alluded to, which boils at 112·8°, distils without decomposition, but detonates when rapidly heated above its boiling-point. Chloropicrin is readily soluble in benzine, sulphide of carbon, ethylic and amylic alcohols, but is not very soluble in ether; chloropicrin dissolves iodine, caoutchouc, resins, cinnamic and benzoic acids. The author gives, further, an account of his researches made for the purpose of converting chloroform directly into chloropicrin, but this did not succeed; we also find a detailed description of the action of chloropicrin upon alcoholic sulphydrate of ammonium, whereby a violent reaction takes place, and there is formed carbonic acid, sulphuretted hydrogen, sulphur, and also an organic compound smelling like garlic.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 12, 1872.

This number contains the following original papers and memoirs:—

Red Colour sometimes observed in White-Lead.—A. Bannow and G. Krämer.—This memoir contains an exhaustive account of a series of experiments made with eight samples of lead obtained from English, Belgian, and German lead-works, each sample weighing about 50 kilos. It should be observed that the red colour sometimes met with in white-lead is considered to be due to the presence of silver in the lead. The authors, abstaining from any *à priori* opinion on this question, have tried to solve it experimentally, and have therefore made accurate analyses of the samples, with the special view to estimate the impurities (foreign metals) in lead, and for the estimation of sulphur in metallic lead. The authors have devised an ingenious method, which consists in the conversion of the lead, while molten, into chloride of lead, the sulphur being converted into chloride of sulphur, which, being decomposed by water, is converted into sulphuric acid. In addition to tabulated forms containing the results of analysis, this lengthy memoir contains the account of another series of experiments, made with different samples of lead converted into white-lead by processes industrially used. It appears that, provided the quantity of silver present in lead is, as is usually the case in soft lead, very small, the reddish tinge occasionally observed in white-lead is due, not to the presence of silver, but to a defective process of manufacture. This extensive memoir is a valuable contribution to the practical knowledge of white-lead manufacture, and also to the metallurgy of lead.

Joint Action of Heat and Pressure upon Paraffin.—T. E. Thorpe and J. Young.—After briefly referring to a memoir on this subject read at a meeting of the Royal Society, the authors state that they have made experiments on the joint effect of pressure and heat upon paraffin on the larger scale. 3½ kilos. of paraffin (fusing at 46°, sp. gr. at 13°=0·906) yielded about 4 litres of fluid hydrocarbons, of which 0·3 litre boiled below 100°, 1·0 litre at from 100° to 200°, and 2·7 litres at from 200° to 300°; there remained a solid residue in the retort, which, on being treated with ether, was found to have as constant melting-point 41·5, and to consist, in 100 parts, of—C, 85·19; H, 15·34. By the action of bromine, this body was found to belong to the $C_nH_{2n}+2$ series. The authors next describe the results of the fractional distillation of these fluid hydrocarbons. After treating the liquids thus obtained with bromine, these substances were found to be—Pentan, boiling-point 35° to 37°; hexan, 67° to 68°, sp. gr. at 18°=0·6631; heptan, 97° to 99°, sp. gr. at 18·5°=0·6913; octan, 122° to 125°, sp. gr. at 15·6°=0·7165; nonan, 147° to 148°, sp. gr. at 13·5°=0·7279. These hydrocarbons are stated to belong to the series—

$$CH_3-\cdots-CH_3\ldots.(nCH_2)-\cdots-CH_3.$$

Acrylic Acid Ether and Acrylic Acid.—W. Caspary and B. Tollens.—By withdrawing the bromine (*entbromung*) from bibrompropionic acid in alcoholic solution, by means of zinc and sulphuric acid, the authors have prepared acrylic acid ether, $C_3H_3O_2.C_2H_5$, a colourless fluid which has a corrosive action on the skin and a very penetrating smell. The formation of this body from bibrompropionic acid is elucidated by the following formula:—

$$C_3H_3Br_2O_2.C_2H_5+Zn=C_3H_3OC_2H_5+ZnBr_2.$$

Free acrylic acid at the ordinary temperature is a liquid, but at −15° it becomes a solid crystalline substance. The authors intend to continue their researches.

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Conveniently Arranged Gas-Evolving Apparatus.—V. Wartha.—The description, illustrated by woodcuts, of apparatus intended for laboratory use.

An Observation.—W. Markownikoff.—The contents of this short notice relate to the rectification of an error made in one of the papers read by the author at a meeting of the Russian Chemical Society, and misreported in its proceedings.

Reduction-Products of Silicic Acid Ether.—A. Ladenburg.—After briefly referring to his former researches on this subject, the author gives an account of silico-heptyl-hydrogen, $Si(C_2H_5)_3H$, a liquid substance boiling at 107°, smelling like benzoline, insoluble in water and in sulphuric acid, soluble in alcohol and ether, sp. gr. at 0°=0·7510, vapour density=118·5. This substance is violently acted upon by bromine, the result being the formation of silico-heptyl-bromide, $SiC_2H_{14}Br$, a fluid which emits dense fumes by exposure to air; it is yellowish coloured, and gradually decomposed by contact with water. Silico-heptyl-hydrogen is strongly acted upon by strong nitric and fuming sulphuric acids. These reactions give rise to the formation of various new compounds.

Nature of the Silicium Compounds met with in Plants.—A. Ladenburg.—Since the brilliant results of the author's researches have proved that there exists a chemical connection between carbon and silicium, the author discusses in this paper the functions of silicium in plants, and supports his views by reporting the results of experiments which seem to show the existence in plants of organic silicium combinations.

On Propargyl-Alcohol.—L. Henry.—Propargyl-alcohol, $C_3H_3-\cdot-\cdot-HO$, is formed by the action of caustic potassa upon monobromated allylic alcohol. The propargyl-alcohol is a colourless, mobile, agreeably-smelling fluid; sp. gr. at 21°=0·9628; boils at from 110° to 115°; vapour density (calculated), 1·93. This alcohol burns in the air with a highly luminous, but sooty flame; its constitutional formula is $CH-\cdot-\cdot-C-\cdot-\cdot-CH_2(HO)$.

On Sappanin.—J. Schreder.—This substance has been discovered by the author in the commercial extract of sapan wood (*Cæsalpinia sappan*) by treating it with caustic soda. Sappanin is a solid, crystalline, white-coloured body, soluble in alcohol, ether, and boiling-water, and insoluble in chloroform, sulphide of carbon, and benzol. The aqueous solution imparts to chloride of iron a cherry-red colour, while with alkaline hypochlorites a grass-green colour is obtained. Sappanin reduces nitrate of silver, and also the Fehling's copper solution. Air-dry sappanin loses, at 100°, 14·17 per cent of water; the empirical formula of this neutral substance is $C_{12}H_{10}O_4+2H_2O$.

Observations on Landolt's Method of Determination of the Molecular Weight of Bodies from the Volume of Vapour, and Proposed Modification of Grabowski's Apparatus for the Estimation of the Vapour Density.—L. Pfaundler.—Notwithstanding the scientific value of this memoir, its contents are not well suited for abstraction.

Origin of Urea in the Animal Body.—O. Schultzen.—This memoir contains the detailed account of some researches and experiments made with living animals for the purpose of elucidating the origin of urea in the animal body. The urine of dogs fed with methyl-glycocol or with sarkosine was found to contain compound ureas, corresponding in quantity with the doses administered of the above-named substances.

Bulletin de la Société Chimique de Paris, Vol. xvii., No. 9, May 1, 1872.

From the *procès-verbaux* of the last meeting of this society, published in this number, we abstract the following particulars:—

Platinic Derivatives of the Terchloride of Phosphorus.—Dr. Schützenberger and M. Fontaine.—The compound $P(C_2H_5O)_3PtCl$ is decomposed by heat, yielding hydrochloric acid, ethylen, chlorated ethylen, and hydride of methyl; the residue contains phosphoric acid and a metallic-looking substance, which appears to contain PCPt. When the above-named compound is dissolved in ammonia, it yields, by evaporation in vacuum, a deliquescent crystalline mass—

$$N_3\left\{\begin{matrix}P(C_2H_5O)_3Pt\\H_4,2HCl\end{matrix}\right.$$

The compound $P_2(C_2H_5O)_6PtCl_2$ also yields—

$$P_2(C_2H_5O)_6Pt\left\{\begin{matrix}\\H_4\end{matrix}\right\}N_3.HCl.$$

Tetrachloride of Naphthaline.—M. Grimaux.—The compound alluded to, $C_{10}H_8Cl_4$, yields, on being heated up to 200° along with water, a body which is soluble in boiling water, crystallisable, fusible at 142°; formula, $C_{10}H_{10}Cl_2O_2$.

The following original papers and memoirs are contained in this number:—

Borate of Lime from Peru (District of Tarapaca).—Dr. Thiercelin.—This memoir treats on the locality where this mineral is found, its origin, and its composition. It appears that the mineral occurs in and near an ancient river bed, while the boracic acid is evidently due to volcanic action. Assuming the mineral to be pure, its composition would be—BoO_3, 41·18; CaO, 16·47; HO, 42·35; but the real composition of the native mineral as found varies greatly, containing as impurities—Insoluble siliceous matter, oxide of iron and alumina, NaCl, SO_3, and NaO. The mineral is evidently a biborate; its formula is $2BoO_3CaO,8HO$. The quantity of BoO found by the author varied from 16·42 to 25·40 per cent. Dilute hydrochloric acid only dissolves the borate, and this property is applied for the purpose of analysis by the author, who treats the finely-pulverised mineral with very dilute HCl (1 to 50 of water).

On Camphic Acid.—Dr. Berthelot.—The author sets forth in this memoir his reasons for not accepting Dr. Kachler's opinion that camphic acid does not exist. It appears that this acid—resulting, according to this author, from the action of alcoholic potassa upon ordinary camphor—has given rise to much controversy and diversity of opinion.

Combinations of Dulcite with Hydracids and Derivatives therefrom.—G. Bouchardat.—This lengthy essay is divided into the following sections:—Combinations formed of dulcite and hydracids without elimination of water; chlorhydrate of dulcite; brombydrate and iodhydrate of dulcite; combinations of dulcite and hydracids with elimination of water (ethers of dulcitè); monochlorhydric dulcitan; dibromhydric dulcite: bromhydric dulcitan; tetrabromhydric dulcitan. This essay is elucidated with a large number of complex formulæ.

Combination of Binoxide of Chromium and Potassic Dichromate; Kalichromic Dichromate.—D. Tommasi.—This paper contains more *in extenso* what has already been noticed (see Chemical News, vol. xxv., p. 214). The formula of the salt alluded to is $[(CrO_3)_3(CrO_3)_3K_2O]H_2O$, or $[(Cr_2O_3(CrO_3)_3)(CrO_3)K_2O]HO_3$.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, May 9, 1872.

The Soumah Iron Mines in Algeria.—C. Mène.—This interesting memoir, elucidated by a series of tables exhibiting the results of analysis of iron ores from these mines, proves that Algeria may become an important iron-producing country; the ores herein described are all of good quality, yielding from 47 to 65 per cent of metallic iron, and all containing manganese, while the insoluble matter is very small in quantity. It appears that the ore is readily accessible, and railways connect the mines with the seaboard.

Foucault's Pendulum for Demonstrating the Rotation of the Earth.—M. Deleuil.—The description, illustrated by a woodcut, of a neatly-made physical instrument for the purpose of elucidating in a lecture-room the phenomenon of the earth's rotation, first exhibited in 1855 in the Panthéon (now Eglise St. Geneviève) by the late Foucault.

Les Mondes, July 11, 1872.

Association Française pour l'Avancement des Sciences.—The first meeting of this association will be held on September 5th in the city of Bordeaux.

Conversion of Electricity into Motion.—Dr. Borlinetto.—The description of an experiment, which can be made with a Holtz's electric machine, whereby the electricity is caused to turn the disc of an electric machine after two large-sized Leyden jars have been introduced into the circuit of the electricity.

Limits of Human Knowledge and Science.—P. A. Cap.

Petites Annales de Chimie.—E. J. Maumené.—The fifth instalment of a monograph treating on the theory of chemistry, illustrated by a series of algebraical and chemical formulæ.

NOTES AND QUERIES.

Laboratory Manipulation.—On page 527 of the *Journal of the Chemical Society* for June, a paper appears, amongst the foreign abstracts, upon two points in manipulation. First, an original method of drying wet bottles is described; and secondly, an ingenious device is named for altering the gauge of glass tubing. It is not my purpose to claim precedence of discovery in reference to either of these communications, though the methods have been employed by me from boyhood upwards; but having contrived a number of expedients for aiding laboratory work, of a similar kind, I do not see what harm it can do me to claim credit for them. As a sample I give a method of emptying large bottles of water in half the usual time. Invert the bottle, and give the contents a rotary motion; the water will then issue in the form of a tube of water, the air entering up the centre without impeding the passage of the water. If this is "abstracted" next month I may feel encouraged to give other processes.—Bottlewasher.

TO CORRESPONDENTS.

*** Vol. XXV. of the Chemical News, containing a copious index, is now ready, price 11s. 4d., by post, 12s., handsomely bound in cloth, gold lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxvi. commenced on July 5th, and will be complete in twenty-six numbers. Reading Cases, price 1s. 6d. each, post free, may also be obtained at the Office.

Black Ash.—Your communication was unaccompanied with your name and address.

Amateur Chemist.—Consult Watts's or Ure's "Dictionary of Chemistry."

Student.—See reply to "Undergraduate," in our Notes and Queries column, No. 651, vol. xxv., p. 239.

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THE CHEMICAL NEWS.

VOL. XXV. No. 661.

ON THE
PHYSICAL NATURE OF THE COAGULATION OF THE BLOOD.*

By ALFRED HUTCHISON SMEE, F.C.S.

AFTER passing in review the principal opinions hitherto entertained on the real nature of the coagulation of the blood, the author states that he is led to refer the solidification of fibrin in the process of coagulation to the same class of phenomena as the pectisation of colloid liquids, as already hinted by the late Professor Graham and others. He points out, at considerable length, the chief circumstances which influence the change in colloidal fluids, and proceeds to compare the properties of colloid silica with an organic body of the nature of fibrin.

ON AN IMPROVED MODE OF ESTIMATING MANGANESE.

By HUGO TAMM.

THE title of this note scarcely reads like fact. Whoever would have thought that room for improvement was left in the estimation of manganese, a metal upon which so much has been written, and for the estimation of which so many ingenious and simple processes have been devised? Yet I hope to have no difficulty in showing that the process which I am going to describe is, on account of its simplicity and accuracy, the true mode of estimating manganese; and I have no doubt that it will be universally adopted for that purpose as soon as it is widely known among analytical chemists.

After manganese has been separated from the substances which usually accompany it, this metal exists in the liquor as chloride of manganese mixed with a strong proportion of ammoniacal salts; and chemists were in the habit of separating manganese from this liquor by means of sulphide of ammonium. The sulphide of manganese obtained, after being washed, dried, and calcined, was re-dissolved in acids, and the solution thus obtained precipitated by carbonate of soda. The precipitated carbonate of manganese, after long boiling, was filtered and washed, dried and calcined, and manganese estimated as the oxide, Mn_3O_4.

This process I need not say was both long and tedious, and attended with real practical difficulties. It was, for instance, difficult to wash thoroughly the carbonate of manganese and free it from carbonate of soda, and generally a complete washing of this precipitate was accompanied by a loss of carbonate of manganese, which, in spite of care and experience in handling it, would pass through the filters.

By the process which I now propose, volatile reagents alone are used, and this, of course, is a most important point; the precipitation is effected in a neutral or slightly acidulated liquor, another important fact; and manganese is precipitated from the liquor in which it exists, after its separation from the substances with which it was originally mixed, in such a condition that the estimation can take place at once, thus saving a deal of time, trouble, and risks.

Consequently we may assume, *a priori*, that this process is very perfect in every respect, and experience will fully confirm this assertion.

* Abstract of a Paper read before the Royal Society.

Estimation of Manganese.

After manganese has been separated from the substances which may accompany it, it is always possible, by means of hydrochloric acid and ammonia, to transform it into a mixture of chloride of manganese and chloride of ammonium; and by a judicious use of these two reagents, and of the test-paper, it is very easy to obtain a neutral or slightly acidulated liquor. In the course of analysis or assaying, this is the condition in which manganese is generally obtained, and it is upon this liquor that the chemist must eventually operate to recover manganese. From the neutral or slightly acidulated mixture of chlorides of manganese and ammonium, manganese can be *thoroughly* precipitated, in the state of *carbonate of manganese*, by means of a slight excess of *carbonate of ammonia*.

In these conditions manganese is not precipitated, as might logically be inferred, as a double carbonate of manganese and ammonia, but as the ordinary protocarbonate of manganese or manganous carbonate, and the precipitation thus effected is so perfect, that in the filtrate it is quite impossible to discover a trace of manganese by means of sulphide of ammonium. Indeed, the precipitation of manganese by carbonate of ammonia, effected in the conditions prescribed, is safer than by means of sulphide of ammonium. I do not mean, of course, the colourless recently-prepared sulphide of ammonium, or the one obtained by saturating the liquor with sulphuretted hydrogen and neutralising by ammonia, for this is a trustworthy reagent, but the yellow sulphide long kept in bottles and which one might be tempted to use.

I have ascertained beyond doubt that in this sulphide, and especially in presence of an excess of chloride of ammonium, both sulphides of manganese and zinc are soluble to an unexpected degree. This solubility may be due to the excess of sulphur usually present in the long-prepared sulphide of ammonium; but I suspect also the presence of an ammoniacal salt of the thionic series. I have not investigated further this reaction, and I must be satisfied for the present, with pointing out the little known but important fact mentioned.

The reaction upon which is based the estimation of manganese is rather startling and unexpected, but the estimation of manganese by this process is quite perfect, and cannot possibly be improved, at least so far as accuracy is concerned. The precipitated carbonate of manganese is allowed to settle in a warm place (boiling not being required) and the whole is filtered. The carbonate of manganese thus obtained is a little denser than the one precipitated by carbonate of soda, and it can be washed with facility with hot water, and if a double filter is used, no trace of the precipitate passes through the filters. After drying, the precipitate is calcined, and manganese is estimated as usual in the state of the oxide Mn_3O_4.

Such is in all its simplicity the improved mode of estimating manganese which I recommend to the attention of analysts. I will now discuss its merits, and expose some of its applications to separation and to analysis.

Separation of Manganese from Lime, Zinc, Nickel, and Cobalt.

After separating manganese from certain groups of substances easy of separation, manganese may still be mixed with lime, zinc, nickel, and cobalt; and the separation of these substances is rather troublesome, but some of them are simplified by the use of the carbonate of ammonia process.

When manganese is precipitated by carbonate of ammonia from the slightly acidulated mixture of chlorides of manganese and ammonium, if lime is present, this earth is precipitated with manganese, and consequently this process is worthless for the separation of those two substances.

When cobalt is present, part of this metal is precipitated in the state of carbonate along with the carb

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manganese, to which it imparts a nice pink colour, and part of it remains in solution. Consequently the separation of manganese from cobalt cannot be effected by means of the carbonate of ammonia process. But when zinc or nickel, or both metals, are present, the separation of these two metals is effected with great perfection, manganese being precipitated as carbonate, and both zinc and nickel remaining in solution. This reaction is rather important, for it is not unfrequently the case that manganese, nickel, and zinc exist in the same liquor, and their usual modes of separation are rather complicated, and this process simplifies them; but from what I have said it must be inferred that, although this process is quite perfect as a mode of estimating manganese, it is not capable of being applied to any extent to the separation of manganese from other substances.

Application of the Carbonate of Ammonia Process to the Estimation of Manganese in Manganese Ores.

On the whole, the chief use of a mode of estimating manganese is the determination of the quantity of this substance in manganese ores. If the ore is contaminated with carbonate of lime, it is first treated with very weak cold nitric acid, which dissolves this substance without attacking sensibly the oxide of manganese, and after a few washings it is treated as an ore containing no carbonate of lime, as follows:—From 20 to 50 grs. of the ore are dissolved in hydrochloric acid, and the mixture is heated until the chlorine evolved is thoroughly disengaged. The solution thus obtained is diluted with water, and filtered in order to collect the insoluble residue; and after being carefully neutralised by ammonia, with the usual precautions, it is precipitated by means of succinate of ammonia. Both iron and alumina are precipitated. The mixture is filtered, and to the clear liquor a slight excess of carbonate of ammonia is added. Manganese is thus precipitated completely in the state of carbonate of manganese. This precipitate is allowed to settle in a warm place; it is then collected on a filter, washed, dried, and calcined, and manganese is estimated as the oxide, Mn_3O_4.

Estimation of Manganese in Native Carbonate of Manganese.

Native carbonate of manganese generally contains carbonates of iron and lime. From 20 to 50 grs. of this mineral are dissolved in hydrochloric acid, and when the solution is complete, a little chlorate of potash is added in order to oxidise iron. It is worthy of remark that, whenever iron and manganese exist in a liquor in the state of protoxide, previous to their separation iron ought to be oxidised by means of chlorate of potash. The use of nitric acid, which is often recommended for this purpose, ought to be carefully avoided for the reason that, while the chlorine from chlorate of potash can be driven off quite easily, leaving the whole of the manganese in the state of protoxide, the chlorine evolved by aqua regia remains in the liquor so long as nitric acid is present there, and the consequence is that part of the manganese exists in the state of sesquioxide, which is precipitated with iron.

After the separation of iron by succinate of ammonia, manganese is separated from lime by sulphide of ammonium, and the sulphide of manganese obtained, being re-dissolved in hydrochloric acid, is precipitated by carbonate of ammonia, as has been previously described. But if no lime is present, manganese is precipitated by carbonate of ammonia, immediately after the separation of iron.

It may not be out of place to remark here that in every instance the separation of iron from manganese ought to be effected by means of succinate of ammonia, and that the separation by ammonia which is recommended by some authors ought to be entirely rejected as defective, owing to the rapidity with which ammoniacal protoxide *of manganese* absorbs oxygen from the air, and is precipitated as sesquioxide. On the contrary, the complete separation of iron from manganese can always be effected with precision by succinate of ammonia, providing the whole of the manganese exists as protoxide, and this condition can always be obtained with absolute certainty if, previously to the addition of succinate of ammonia, the neutral liquor containing iron and manganese is boiled for a little while.

Estimation of Manganese in Native Carbonate of Iron and in Spiegeleisen.

Native carbonate of iron often contains a small proportion of manganese, and spiegeleisen contains from 8 to 12 per cent of manganese. 100 grs. of the mineral are dissolved in hydrochloric acid, and the solution is oxidised by chlorate of potash. 100 grs. of spiegeleisen are dissolved in hydrochloric, with addition of chlorate of potash, or in aqua regia, but in this case the solution must be evaporated to dryness before operating upon, in order to remove every trace of nitric acid. In both instances iron is separated from manganese by succinate of ammonia, and in the filtrate manganese is precipitated by carbonate of ammonia. If lime is present, manganese must of course be separated from this earth by the usual methods before it can be estimated.

These are the chief instances in which the estimation of manganese is useful.

I will not end this note without remarking that the general method of precipitation from neutral or slightly acidulated ammoniacal liquors is capable of being applied to various analytical uses, and in general with great practical advantages.

INFLUENCE OF CHANGES IN BAROMETRIC PRESSURE ON ANIMAL LIFE.

THIS subject has recently been studied by M. Bert, and he communicates to the Paris Academy, in a series of notes, an account of his researches, of which the following is an outline:—

The experiments were made in the physiological laboratory of the Sorbonne. M. Bert first of all communicates certain facts relative to the death of animals subjected to pressures inferior to mean atmospheric pressure, and the state of the air in which they died.

When the pressure to which a warm-blooded vertebrate is subjected is *suddenly* reduced to 15 or 18 centimetres of mercury, the animal is seized with convulsions, and soon dies; and this is the case, whether the receiver is quite closed, or a current of air is allowed to pass through it. But if the pressure is *gradually* reduced, it is possible to keep the animal alive at very low pressures, provided the air about it is being constantly renewed. If the receiver is then closed, the animal dies of asphyxia.

In each case, the capacity of the receiver was inversely proportional to the pressure experimented with. The pressure was gradually lowered to the desired point (as the animal appeared able to bear it), the air being constantly renewed. Then the receiver was closed.

In this way, it was found that birds could not be kept living under 18 centimetres; mammals could bear 12 centimetres; for cold-blooded animals the pressure might be lowered still further.

For the same pressure, the animals which left most oxygen and produced least carbonic acid were kestrels, owls, and grown cats; next followed sparrows, frogs, and kittens; lastly, guinea-pigs.

The quantity of oxygen left in the air after death was greater in proportion as the pressure was less. The opposite was the case with the CO_2.

The numbers for one example may here be given, showing the differences in the composition of the air after death:—

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Sparrows.—Pressure of 76·4 c. : CO_2 15·4 p.c.; O 3·6

55·0 c. : CO_2 14·7 ; O 3·6	26·0 c. : CO_2 7·8 ; O 11·2
47·0 c. : CO_2 14·2 ; O 5·2	19·7 c. : CO_2 7·1 ; O 12·8
37·0 c. : CO_2 11·5 ; O 7·4	18·0 c. : CO_2 2·8 ; O 18·0
30·0 c. : CO_2 10·1 ; O 8·7	

Now, in the above cases, the animal's death does not arise from mere diminution of pressure, interfering directly, as a physical agent, with the respiratory movements, or those of circulation ; for a sparrow, *e.g.*, may be kept alive at 12 centimetres pressure if oxygen be allowed to enter, whereas it would die at 18 centimetres pressure if the receiver were kept closed. The death is due to the fact that the pressure of the oxygen in the enclosed space is not sufficient to preserve in the blood the quantity of oxygen necessary to the vital functions.

In a second series of experiments, the confined air was raised above the normal pressure. The animals were sparrows, rats, and frogs. It took about fifteen minutes to produce a pressure of seven atmospheres. However quickly the required pressure was reached, the animal did not seem much affected ; the breathing became gradually slower till symptoms of asphyxia commenced, and the animal succumbed without convulsions, having a temperature of 22° to 27°, or a little above that of the surrounding air. It is clear that the animal had at its disposal quantities of air, and therefore of oxygen, proportional to the pressure employed ; yet, whatever the pressure, death ensued always in very nearly the same time (about three hours for sparrows). And though the pressure was increased by injecting fresh air, the animal was not relieved ; it was relieved, on the other hand, when the air was allowed to escape.

After death, the blood in the arteries and in the veins was, in most cases, very red, and bubbles of gas were found in the right cavity of the heart.

As to the composition of the air in which the animals died, here are the results for sparrows :—

	Carbonic acid.	Oxygen.
Normal pressure	16·0	3·5
1½ atmospheres	15·2	2·6
2 ,, ...	13·7	5·0
2½ ,, ...	11·3	8·5
3½ ,, ...	7·2	11·1
5 ,, ...	5·6	13·8
7 ,, ...	4·0	15·9
9 ,, ...	3·0	17·2

Generally, the greater the pressure, the less did the animal alter the air at its disposal.

It further appears that, for 2 atmospheres and upwards, the value of the pressure of the carbonic acid is always nearly the same. Thus, 13·7 per cent of carbonic acid at 2 atmospheres represents, at normal pressure, $2 \times 13{\cdot}7 = 27{\cdot}4$; at 2½ atmospheres, 11·3 per cent represents $2{\cdot}5 \times 11{\cdot}3 = 28{\cdot}25$; in the same way, $3{\cdot}75 \times 7{\cdot}2 = 27$; $5 \times 5{\cdot}6 = 25$; $7 \times 4 = 28$; $9 \times 3 = 27$.

Death takes place when the carbonic acid contained in the venous blood is unable to escape across the lungs, owing to the pressure of carbonic acid in the atmosphere. And we are led to the conclusion : That a sparrow necessarily dies when there is in its venous blood such a quantity of carbonic acid as equilibrates the pressure of 26 or 28 per cent carbonic acid in the external air. For mammifers, the number is slightly higher ; for reptiles, it falls to 15 or 16. This explains how the birds died all in the same time, whatever the pressure, and how injected air did not relieve them.

The numbers arrived at by experiment led to the further principle that, as regards normal and lower pressures, a sparrow necessarily dies when the quantity of oxygen contained in its blood equilibrates a pressure of about 3·5 of oxygen contained in the external air.

It appears that the proportion of gases in the blood may occasion the death of an animal in three ways—(1) through insufficiency of oxygen (the pressure of the air being 1 atmosphere or under) ; (2) excess of carbonic acid (pressure of 2 atmospheres and upwards) ; (3) both of these combined (pressures intermediate between 1 and 2 atmospheres).

M. Bert next endeavoured to find whether the law relative to the proportion of carbonic acid held good under two atmospheres, by eliminating the cause of death, which consisted in deficiency of oxygen. He used atmospheres which were richer in oxygen than common air. Down to 25 centimetres pressure the law was verified ; *i.e.*, the number expressing the quantity of carbonic acid, multiplied by the number expressing the pressure gave 25, or nearly so. Below 25 centimetres there was divergence.

The explanation given is, that at these low pressures the proportion of oxygen, considered in relation to the normal pressure, is a very small one, and that even in these superoxygenated atmospheres the animal dies of want of oxygen.

On the above principles, it ought to be possible to keep a sparrow alive in an atmosphere of pure oxygen with a pressure little over 2·66 c.

Animals were next confined in superoxygenated air, the pressure of which was over 2½ atmospheres. Here the law above indicated was departed from. But an unforeseen result was met with. When the pressure was raised to 4 or 5 atmospheres, the animal gave signs of suffering and fell into convulsions, which were repeated up to the time of its death (in less than half an hour). These violent effects could not be due simply to pressure, for in common air the animals bore a pressure of 8 or 9 atmospheres without inconvenience. They are due to the larger proportion of oxygen, which, entering the blood, acted poisonously. To produce the same results by simply using air, it would be necessary to exceed 14 atmospheres. Oxygen, therefore, when its proportion in the blood is notably increased, acts as a poison.

At a later period, M. Bert was able to apply a pressure of 20 atmospheres. With common air, the convulsions due to poisoning by oxygen appeared at 15 atmospheres.

Still M. Bert thinks (and he gives proof of it) the injurious action of oxygen must not be supposed only to commence there. It begins to act thus at 6 atmospheres, or (as more refined experiment may yet show) at even lower pressures.

The benefit derived from use of compressed air-baths, on the one hand, and many of the accidents that happen to workers in mines, in diving-bells, &c., on the other, appear to be due, in great part, to the introduction into the system of a quantity of oxygen greater than in the normal state ; and it is with oxygen as with other poisons, small doses of which may be salutary.

If aëronauts, who are stopped in their upward course, not by failure in the balloon, but by the impossibility of living, wished to soar higher, they might accomplish this if they took with them a supply of oxygen to which they could have recourse when the air became too rare. The mechanical arrangements for breathing this conveniently can be easily conceived.

On the other hand, the industries which subject workmen to pressures over 5 or 6 atmospheres entail suffering and death ; which evils might be remedied if there were substituted for the air a mixture of air and nitrogen, calculated so that the pressure of the oxygen should not exceed a certain low limit. A. B. M.

ON THE

EVIL EFFECTS OF THE USE OF ARSENIC IN CERTAIN GREEN COLOURS.*

By FRANK W. DRAPER, M.D.

(Continued from p. 31).

II. *Confectionery, Pastry Ornaments, and Toys.*—It would seem hardly possible that any person, save the

* From the "Third Annual Report of the State Board of Health of Massachusetts."

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most reckless or the most malicious, would designedly introduce into articles of food agents of such poisonous potency as the green colours containing arsenic. Ignorance of the properties of Schweinfürt green must have been the only extenuation for the great majority of those confectioners who have ever made use of that substance to impart to their wares a luring but most treacherous colour. Doubtless all the colouring materials which are used so abundantly to give to candy its variegated hues should justly be subjected to the closest scrutiny, and many of them should be unconditionally condemned in view of the baneful effects which they necessarily produce, especially in children. It needs no argument to demonstrate the probable results of the swallowing of even the smallest portion of a colouring material which contains more than one-half its weight of pure arsenic; and a single word of warning ought to suffice to banish such sugar-coated poison from candy-shop windows.

It is a matter for congratulation that, as the result of stringent regulations in other countries, together with a more general enlightenment of the public in such matters, accidents from the use of the metallic pigments in confectionery are now comparatively rare. Repeated and fearful experiences in the past, of which the victims were chiefly children, have borne their fruit. It would probably be a difficult task at the present day to find the arsenical greens designedly incorporated as a colour into any candy intended for eating. It would be better for the community if experience had taught similar abstinence concerning the green pigments in other relations.

Accidents do, however, occasionally occur from the ornaments with which confectioners adorn their pastry, and which are not meant to be eaten. These are not unfrequently coloured in the most reckless manner with emerald green. Misadventures from this source generally affect children who, attracted by the colour and the candy-like aspect of the ornaments, eat them inadvertently. A number of cases of this sort are reported. In one such instance, two children ate a portion of a cake ornament which was coloured green, and narrowly escaped death. Ten grains of the coloured pastry contained nearly 2½ grains of arsenic.* Dr. Fergus reports a similar experience, in which three children were poisoned, exhibiting all the typical symptoms of the effects of arsenic.† In 1857, in Edinburgh, eighteen persons were made very seriously ill, and one child died, after eating a pastry ornament which owed its green colour to arsenite of copper.‡

The ingenuity of caterers has sometimes shown itself in the presentation of the triumphs of their art in a unique manner. M. Chevallier relates, that at a grand dinner-party in Paris, attention was directed to a boar's head which had been curiously decorated for the occasion. The ornament consisted of masses of fat, coloured alternately red and green, so arranged as to give quite an artistic effect. One of the guests, well acquainted with chemistry, was struck with the rich green colour, and reserved a portion for private analysis. He found the colouring matter to be pure Scheele's green, forming about 2 per cent of the weight of the fat. It appeared, on inquiry, that the butcher's boy had procured the colour from an adjacent shop, in spite of the regulation prohibiting its sale.‖

The toys of children are a medium by which these poisonous pigments may be introduced into the system and cause grave accidents. Many of the green wooden toys are painted with Schweinfürt green loosely applied, the colour being mixed with water only and smeared on the wood, instead of being more securely fixed upon the material by means of oil or varnish; and when one remembers the instinctive habit of young children to carry to their mouths whatever their hands contain, the liability to injury is at once apparent. Moreover, children's hands are always moist, and this moisture can readily dissolve and detach the loosely applied colour. The hands thus soiled are put to the face, and, as likely as not, in the mouth. This custom of using the metallic colours on toys is the more reprehensible since it is wholly unnecessary, or, if any colour is desirable, vegetable pigments should be substituted. Chevallier cites two cases of acute arsenical poisoning in children from the source alluded to, and remarks "It is a matter of surprise that other cases have not been brought to the notice of the public, since children are so often seen playing with those cheap toys, with their hands abundantly daubed with yellow, red, and green."*

The boxes of water-colours which are in such common use as a plaything for children, contain generally two blocks of green paint, one being of a dark and the other of a light shade. The latter consists of arsenical green. A tablet of this kind, weighing 38·26 grains, was analysed for the writer by Mr. A. H. Pearson at the laboratory of the Massachusetts Institute of Technology, and found to contain 8·89 grains of arsenic. A child in using these paints will frequently carry the brush to his mouth, in order to moisten it with saliva before applying it to the colour, and sometimes the paint is itself touched directly to the tongue. It is marvellous that more frequent cases of poisoning from this source do not occur, because not only the green colour, but others also of the blocks, are composed of matters of a positively harmful nature. Must it not be considered as hardly less than criminal in the manufacturers of toy paint-boxes to distribute a colour containing so large a proportion of one of the most irritant poisons?

It has happened that children, too young to know the use or nature of these paints, have eaten portions of them, and have been seriously poisoned in consequence. Such an instance was reported in 1859 by Dr. Rose; the child took only a small fragment of a green paint, and in half an hour he became cold, pulseless, and fully collapsed. Only by the vigorous application of the proper antidotes to arsenic was the child's life saved.† Four cases, precisely analogous in character, are recorded by Chevallier.‡

III. The arsenical pigments are sometimes used in the *inside painting of houses*, and in this relation they merit a single word. The dangers to health arising from this source are, of course, comparatively unimportant in America, where taste and fashion prescribe the general use of white-lead for these purposes of house painting. In some parts of Europe, however, the use of mineral green has been deemed a matter of sufficient importance, on account of its extent, to warrant an investigation into the effects which may occur. M. Kirchgässer, of Coblentz, published, in 1867, the results of his researches on this subject, and demonstrates the deleterious effects of habitually staying in rooms on whose walls is a coating of arsenical green. The symptoms in such cases are those of chronic arsenical poisoning, and they are identical with those due to exposure under other circumstances; the most characteristic are excessive debility, intermitting pains, cold extremities, a cachetic aspect, and sometimes the appearance of brown patches on the skin.

Dr. Lorinser also asserts his unqualified opinion that chronic arsenical poisoning may occur in consequence of the occupancy of rooms whose walls are painted green, and which owe their colour to the arsenical pigments. Numerous cases occurring in his own experience are cited to demonstrate his statements.‖

The following instance illustrates how accidents may arise through inadvertence from the use of arsenical green paint. The experience is not improbable in our own community where the paint is sometimes used on

* *London Med. Times*, 1849, p. 107.
† *London Med. Gazette*, vol. 43, p. 304.
‡ For numerous other cases, see Taylor "On Poisons," 2nd Ed., p. 431.
‖ *Annales d'Hygiène*, new ser., vol. xii., p. 69.

* *Annales d'Hygiène*, 2nd ser., vol xix., p. 304.
† *Lancet*, 1859, vol. i., p. 237.
‡ *Annales d'Hygiene*, new ser., vol. xii., p. 94.
‖ *Wiener Med. Wochenschr.*, 1859, Nos. 43 and 44.

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shelves and such other limited surfaces. A distinguished English chemist, Professor Taylor, observed, adherent to the under crust of the loaf of bread which had been placed one morning before him for breakfast, certain well-marked patches and streaks of a green colour, having the appearance of green mould. He removed some of the suspicious matter, and, subjecting it to analysis, proved it to be composed of "Scheele's green, containing about 50 per cent of arsenic." There was enough on one of the loaves to have killed an infant. On inquiry, it was ascertained that the baker, from whom the bread had been purchased, had just had his shop newly decorated, and there were eight long shelves (holding some hundreds of loaves) painted a bright grass-green colour, top, front, and sides. A number of the loaves were examined in succession, and it was found that they were all similarly stained. They had been placed while warm on the shelves, and had absorbed a quantity of the freshly-applied poisonous pigment. "The baker expressed his ignorance that there was arsenic in the paint; but the painter, who was summoned, took the matter more coolly and professionally, remarking that it was impossible to get a good green without arsenic, that he had used it for many years, and he had never heard of anyone being killed by it." The author remarks: "It is easy to conceive that an accident of this kind, if undetected, might lead to serious results, and perhaps to very erroneous suspicions."*

A case analogous to the foregoing occurred in Vienna. An entire family were made seriously ill by eating strawberries which had been kept a few hours in a box whose inner surface was painted green. The paint, on analysis, was found to be coloured with arsenite of copper.†

IV. Every person must be familiar with the appearance of the brilliant *green paper* which is used so extensively for covering paste-board boxes, for show-cards, for tickets, for wrappers, for lamp-shades, and for a great number of similar purposes. This paper owes its bright tint in all these forms to the presence of arsenite of copper. It contains a large amount of the poisonous material in proportion to its weight.

The accidents to which this method of employing arsenic may give rise are, as will readily be seen, chiefly of an acute order, and grow out of the danger, to which children are especially liable, of swallowing the poison in the manner alluded to in connection with toys. The matter has received particular attention in France, and the use of arsenical green paper for the purpose of enveloping articles of food, confectionery, and the like is absolutely prohibited. In his instructions to his subordinate officers, the Prefect of Police of Paris applies the interdiction of these papers to "bags, envelopes, boxes, or labels as used by all dealers in provisions or articles of food whatsoever."‡

Such a sweeping proscription would certainly appear impracticable in our own community, but it serves to illustrate the magnitude of the subject as it is regarded in other countries. Certainly the very general use of the material in question, under a great variety of forms, must be obvious to the most casual observer, and when the eye once becomes accustomed to the characteristic shade, and looks for it, it is surprising to observe to what a multiplicity of uses the paper is applied. It will not be unprofitable, therefore, to utter a word of warning concerning the dangers which are possible, and to cite cases which exemplify them.

Perhaps the most reprehensible use to which the green paper is put is as a wrapper to packages of confectionery, chocolate, and the like, a practice which is becoming too common. On of the most reputable of the confectioners of Boston displays in his windows and on his shelves, with other confectionery of his own manufacture, rolls of lozenges enveloped in the bright green paper; and the same custom is to be repeatedly observed in other stores. Children, readily allured by the bright tint, obtain this candy, and if they do not swallow a portion of the poison with the sweatmeat, are not generally unready to put the paper wrapper to their mouths, child fashion. A case is recorded by Chevallier in which a child was poisoned in this manner by a piece of green paper. The mother of the child had given him a fragment of chocolate, around the end of which, for the sake of neatness, she had wound a portion of the paper in which it was originally enveloped. In sucking the candy, the child also took into its mouth some of the colouring matter from the paper, and narrowly escaped death in consequence.*

An accident like the following is likely to occur at any time to an organism equally sensitive to the action of poisons, where price-cards covered with arsenical green are so freely used:—

"A lady purchased a quantity of prunes, of which she cooked a portion. Soon after eating some of them she was attacked with vomiting, which continued several hours. Not suspecting the cause of her illness, she took more of the prunes, and suffered a recurrence of the symptoms. Then it was noticed, on careful search for the cause of her trouble, that some of the fruit was stained with green. On returning the prunes to the grocer, he recognised the fact that the colour proceeded from a green price-card which had rested on them; the fruit, being moist, had taken up a portion of the colouring matter from the paste-board. The pigment was found to consist of Scheele's green."†

The instance which follows is also suggestive of a quite common exposure:—

"A watchmaker had a very troublesome and irritable ulceration of the mucous membrane of the mouth. The smarting and annoyance were almost intolerable, and became much increased in the evening, when the lips swelled and became so painful that eating, or even speaking, could scarcely be indulged in. In prosecuting his work, he was in the habit, in the evening, of using a gas-light, before which, to protect his eyes, he had a bright green paper shade. On analysis, the colour of the shade was found to be due to the presence of aceto-arsenite of copper (Schweinfürt green). The heat from the light was believed to have decomposed a portion of the arsenical pigment, producing the characteristic odour and causing the acute symptoms in the workman. Speedy recovery followed the disuse of the shade."‡

In 1861, the following case occured in Boston, and was reported in one of the local medical societies:—A young child, in playing with a small green concert ticket, put it to his mouth, and detached and swallowed a portion of the pigment. Violent symptoms followed. A duplicate ticket was analysed quantitatively by Dr. C. T. Jackson, and was found to contain in its green coating nearly 2 grains of pure arsenic.‖

(To be continued).

* *Medical Times and Gazette*, April, 1854, p. 326.
† *Oester Med. Wochensch.*, 1841.
‡ *Circulaire aux Com. de Police de Paris*, Nov. 28, 1855.

ON DYES AND DYE-STUFFS OTHER THAN ANILINE.§

By Dr. F. CRACE CALVERT, F.R.S.

Alkanet.—The root of the *Anchusa tinctoria* contains a beautiful red resinous principle, to which Professor Bolley assigns the formula $C_{35}H_{40}O_8$, which is insoluble in water, but soluble in alcohol, ether, and bisulphuret of carbon. To all these solvents it communicates a fine purple colour, which becomes blue on the addition of an alkali. It is not at the present day employed as a dye-stuff, its chief uses being in pharmacy to colour medicines;

* *Annales d'Hygiene*, vol. xix., p. 304.
† *Ibid.*, vol. xii., p. 71.
‡ *Lancet*, Jan. 7, 1860, p. 8.
‖ *Boston Med. and Surg. Journ.*, vol. lxiv., p. 121.
§ The Cantor Lectures, delivered before the Society of Arts. Revised and communicated by the Author.

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in perfumery, to colour oils and greases; and in domestic life to give a tint to the lime-wash used for the walls of private dwellings.

Safflower.—Although this dye-stuff has lost much of its value since the discovery of the aniline colours, it is still extensively used in Lancashire for the production of peculiar shades of pinks for the eastern markets. It is also used for dyeing red tape, and I know no more striking instance of red-tapeism than the love which is shown for this particular dye by the users of this article. Much cheaper pinks can be produced from aniline, and, notwithstanding that many times the attempt has been made to introduce them, it has in every instance failed, because the exact shade has not been attained.

Safflower is the bloom of a peculiar thistle called *Carthamus tinctorius*, which is cultivated in France, Egypt, Spain, Italy, and India. In France and Spain, the small flowers composing the heads of the thistle are picked off and dried in the shade, whilst in Egypt and India they are squeezed, washed with cold water to remove useless materials, slightly pressed into lumps, and dried in the shade; the latter have about double the value of the former. The safflower so prepared only contains 3 to 6 parts per 1000 of the colour-giving principle.

This principle has received the name of carthamic acid, and has the formula $C_{14}H_{16}O_{14}$. A solution of this acid, when dried on a polished white surface, leaves a varnish, having a beautiful red colour by transmitted light, whilst it assumes the iridescence of cantharides when seen by reflected light. It is insoluble in water and ether, but soluble in alcohol. This solution becomes yellow on the addition of sulphuric, nitric, or hydrochloric acid. It is also turned yellow or orange by weak alkalies, and the colouring matter in this latter solution undergoes rapid alteration if exposed to the atmosphere. It is owing to the fugitive nature of the colour, and its easy modification by acid and ammoniacal vapours, that the delicate pinks produced from safflower have been so successfully replaced by the pink aniline dyes.

To prepare carthamic acid, safflower is introduced into bags and washed, till a yellow colouring matter which it contains is removed. It is then mixed with water, to which is added 15 per cent of the weight of safflower taken of crystallised carbonate of soda. After two hours' maceration, the liquor is run off, and cotton yarn dipped in; then lemon juice or citric acid is added to liberate the carthamic acid, which fixes itself on the yarn. Up to this point, the process is the same as that adopted in dyeing fabrics, but to obtain the acid, it is necessary to treat the washed cotton a second time with carbonate of soda, which dissolves out the carthamic acid, leaving a second yellow colouring-matter fixed on the cloth. The carthamate of soda thus obtained is decomposed by tartaric acid, and the carthamic acid falls as a brilliant red amorphous powder, which, when mixed with a little water, is sold as safflower extract, and when dry and mixed with ground talc, is employed as *rouge* by ladies.

There is a particular extract extensively used in dyeing, the preparation of which is a secret. Its value depends on the fact that the carthamic acid is rendered soluble in water.

Cochineal, Kermes, Lac-dye, and Murexide.—I shall now call your attention to four colours derived from the animal kingdom, namely, cochineal, kermes, lac-dye, and murexide.

The first three are distinct species of a peculiar tribe of insects called *Coccina*. The females, from which alone the colouring-matter is derived, form a mass nearly destitute of limbs, and remain attached to one spot on the plants infested by them. The males, on the contrary, are very minute and really elegant creatures, furnished with a single pair of filmy wings. The real cochineal is called *Coccus cacti*; kermes, *Coccus ilicis*; and lac-dye *Coccus lacca* or *ficus*. They all contain the same colouring principle. Although the dyes derived from some species of these insects were well-known to the ancients, and were much used in Persia and India, the true cochineal has only been known in Europe since the discovery of America by the Spaniards; and since the year 1830 only has it been propagated in the Canary Islands, the island of Teneriffe, Java, and Algiers. The best qualities are still obtained from the republic of Honduras.

The *Coccus cacti* lives on a species of cactus called the *nopal* or *Opuntia cochinilifera*. This plant is indigenous to Mexico, where it grows in the wild state; and from it large quantities of cochineal are collected. It is also extensively cultivated by the native Indians, who often have plantations containing 60,000 plants. The cochineal obtained from the two sources is of different quality; that from the cultivated plant is much superior, and is called *mestique*; that collected from the wild plant is called *sylvestra*.

I will now explain, in a few words, how cochineal is propagated and prepared for market. In the month of May, in the flat lands, and in November in the mountainous districts, the Indians take the stems of the cactus, which they have preserved from a previous crop, and remove from them the young female insects, which are placed on the growing plants, where they grow and multiply with great rapidity. After a period of about three months, the insects are collected into small tin dishes, so formed as to enclose the bottom part of the plant, and by means of a small brush they are swept from each stem successively into it. They are then destroyed, either by being thrown into hot water and afterwards dried in the sun, or in stoves, which gives the black cochineal, called *zacatilla*, or they are placed in a bag and stoved at once, which leaves upon them that peculiar lustrous appearance which characterises the silver-white cochineal, called *blanco*. Although 1lb. of cochineal contains 70,000 insects, there are millions of pounds imported into Europe every year.

If one of the dried insects be placed in warm water it swells, and takes a hemispheric form, when its structure can be seen. If it is pressed between the fingers, thousands of little red grains are exuded, which, if placed under the microscope, are seen to be minute cochineal insects.

The colouring-principle was first isolated in an impure state by Pelletier, who considered it to be an azotised compound. MM. Arppe and Warren de la Rue, however, found that it contained no nitrogen, and that it had the formula $C_{14}H_{14}O_8$. As it had distinctly acid properties, they gave it the name of *carminic acid*. M. Schützenberger proved that carmine is composed of carminic acid and an organic azotised base called *tyrosine*.

MM. Arppe and Warren de la Rue obtain crystallised carminic acid by the following process. The cochineal is treated with ether, to remove fatty matters, then boiled in water. An acid acetate of lead is added to the solution thus obtained, which precipitates an insoluble carminate. This, after being washed carefully, is decomposed with sulphuric acid, the carminic acid being liberated. The aqueous solution is evaporated to dryness, and the mass treated with alcohol, which, on evaporation and cooling, yields it as a crystalline mass.

As shown by the above process, carminic acid is insoluble in ether, but soluble in water and alcohol. It is dissolved without decomposition by concentrated sulphuric and hydrochloric acids. Carminic acid yields on fabrics, especially on wool, one of the fastest colours known, light and air having no action on it. Chlorine, however, easily destroys it. An aqueous solution of the acid gives the following characteristic reactions. With caustic alkalies, it gives a beautiful crimson-red colour; with oxymuriate of tin, it gives a red precipitate; and with cream of tartar or oxalate of potash, an orange-red precipitate. Alumina removes the whole of the colouring-matter from an aqueous solution. As cochineal is an expensive dye-stuff, it is subject to much fraud and adulteration. One of the most common frauds is practised at Nismes and

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other places where perfumery is largely prepared. The cochineal in those localities is put into water for a short time, by which a part of its colour is extracted; it is then dried, and either sold as black cochineal, or placed in a sack and shaken with talc or sulphate of lead, and sold as white cochineal. This fraud is easily detected by grinding the cochineal, and mixing it with water, when the talc or sulphate of lead falls to the bottom. Good cochineal does not leave above 5 or 6 per cent of ash.

It is often advisable before buying cochineal to determinate its tinctorial power. This may be ascertained by two or three methods. In the first, equal weights of the cochineal to be assayed, and of one of known value, are treated with alcohol or a solution of alum. The solutions thus obtained are poured into tubes, and placed in a colorometer. This is an oblong box, which has two apertures at each end and two on the top, in a direct line with the end apertures. The tubes are placed through the openings on the top, and, on looking through the end apertures, any difference in intensity of colour between the two liquids can be observed. If a difference is detected, alcohol or water is added to the stronger liquor until there is perfect uniformity of tint. According to the amount of dilution required is the relative value of the cochineals.

A good process was published by the late Dr. Penny, of Glasgow. It consists in exhausting a grm. of cochineal with 50 grms. of potash solution, and this extract is further diluted with 100 grms. of water. The solution thus obtained is mixed with a graduated solution of ferricyanide of potassium (1 grm. of salt to 200 grms. of water) till its colour changes to a dark brown. A solution of bleaching-powder of known strength can also be used for the same purpose. The best method consists in dyeing equal surfaces of flannel in a bath composed as follows:—

For Scarlet Tints.

	Grms.
Water	1250
Cream of tartar	2
Tin composition	2
Cochineal	1

For Crimson Tints.

	Grms.
Water	1250
Cream of tartar	0·75
Alum	1·50
Cochineal	1

The pieces are then washed and dried, and, by a comparison of the relative intensity of shade, the value of the cochineal is determined.

The chief employment of cochineal is for dyeing wool, but it is also employed in calico printing to produce pinks and reds in steam styles.

It will no doubt be interesting to you to know how to determine whether a pink has been produced from a dyewood, a cochineal, or from madder. All these colours are destroyed by chlorine or bleaching-powder. A boiling soap solution destroys the wood pinks, communicates a crimson hue to the cochineal dye, and brightens the madder colour. Dipped in a rather dilute solution of hydrochloric or sulphuric acid, fabrics dyed with cochineal are not affected, while those dyed with madder or woods assume a yellow tint, which becomes purple when placed in milk of lime. These cloths, however, if subsequently soaped, will yield their colour if dyed with wood, but not if dyed with madder.

Ammoniacal Cochineal.—When 1 part of ground cochineal is left in contact with 3 parts of ammonia for several weeks, a chemical action ensues, by which the ammonia loses one equivalent of hydrogen, which unites with an equivalent of oxygen of the carminic acid, giving rise to water and an amide compound, carminamide. Adopting M. Schützenberger's formula for carminic acid, the change may be thus represented:—

Carminic Acid. Ammonia. Water. Carminamide.

$$C_9H_8O_5 + NH_3 = H_2O + C_9H_9NO_4.$$

This compound is also used for dyeing, but before employing it for this purpose it is necessary to add 4 per cent of alumina, in the state of jelly, to the mixture described above. The mass is then slowly evaporated to the consistence of a thick paste. By this means all excess of ammonia is expelled. This preparation is used for dyeing silk, and to produce violet and mauve colours on woollen goods.

(To be continued.)

TECHNOLOGICAL EXAMINATIONS.

ON Saturday, the 20th inst., Prince Arthur presided at a conference at the Society of Arts on the promotion of technical education among the working classes of this country. The assembly included the Lord Chancellor, Sir John Pakington, M.P., Lord Henry Lennox, M.P., Lord De l'Isle and Dudley, Lord Clarence Paget, Lord Alfred Churchill, Major-General F. Eardley-Wilmott, Admiral Ommanney, Professor Huxley, Dr. Lyon Playfair, M.P., Dr. Frankland, Professor Tennant, Captain Donnelly, Dr. De la Rue, Captain Galton, Professor Hughes, and Professor Goodeve.

The Secretary read the Report of the Council, which stated that if this country was efficiently to maintain its manufacturing supremacy in the markets of the world, the technical education of our artisans must be improved; and the Council were of opinion that technological examinations would be of great use in furtherance of this end. The Council had had before them a proposal by Captain Donnelly, that the Society of Arts should establish examinations in the science and technology of the various arts and manufactures of this country, and they proposed to hold the first technological examination in 1873, when the subjects would be the manufacture of cotton and paper.

HIS ROYAL HIGHNESS concluded a practical and able speech by saying:—The Society of Arts are endeavouring to encourage, among those who are practically employed in various industries, the study of art, and an accurate knowledge of its application in each branch of manufacture. The Society will not, however, attempt to teach the practice of those arts. Their object is rather to lay a sound foundation of all the principles on which those practices may be carried out to the best advantage. The Society wish and desire to give certificates, prizes, and scholarships, to those who show that to practical skill as workmen they have added an accurate knowledge of natural principles in those matters. I am certain the necessity and advantage of combining scientific principles with practice will be seen by all. I only wonder that we are but just beginning to undertake this task. The machinery for these technological examinations already exists, and, in fact, the skeleton of industrial Universities is ready to our hands. What we now require is funds to clothe it with and give it life, and to enable it to carry out its work—that is, to obtain sufficient prizes to encourage and reward the deserving youth of this country. If others would only do what Sir Joseph Whitworth has done by his noble endowment for mechanical engineering, we might soon hope to see our most sanguine expectations realised.

The LORD CHANCELLOR briefly moved the first resolution, which approved of the proposed scheme of technological examinations, and considered it well worthy of general support, with the view of meeting the admitted general deficiency of technical knowledge in this country.

Dr. LYON PLAYFAIR, M.P., seconded the resolution, which was carried.

Mr. WATNEY, the Master of the Mercer's Company, moved that this meeting trusts the advancement of technological knowledge in the manner proposed may be

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viewed by the City Guilds, and other like bodies, as an object well worthy of their support and material assistance. He expressed his belief that the Livery Companies were not, as was generally imagined, opposed to the resuscitation of technical education, and would support any good scheme with that view.

Dr. Warren de la Rue seconded the resolution, remarking that if the City Guilds would only contribute a small portion of their funds towards raising the scientific standard of English workmen, it would prove a good investment for the country.

The resolution was carried unanimously.

Sir J. Pakington, in moving the next resolution, which directed the formation of a committee, consisting of the masters of the city companies, the leading manufacturers and scientific professors, and the members of the Society of Arts, urged that the elementary education of the people having been provided for, there was now no longer any excuse for further delaying the consideration of the important question of systematic technical instruction, and that, unless the matter was vigorously taken up, Germany and France would steal ahead of us, while we were supinely thinking we were guiding the manufactures of the world.

Lord De l'Isle and Dudley seconded the resolution, which was carried.

A cordial vote of thanks to Prince Arthur for presiding brought the proceedings to a close.

NOTICES OF BOOKS.

A Handbook of Chemical Technology. By Rudolf Wagner, Ph.D., Professor of Chemical Technology at the University of Wurtzburg. Translated and edited from the Eighth German Edition, with extensive additions, by William Crookes, F.R.S., &c. With 336 engravings on wood. London: J. and A. Churchill. 1872.

It cannot be denied that, as regards good handbooks on scientific subjects, we are greatly indebted to the zeal and active industry of the Germans; and as regards works on technology, this is still more prominently the case, for in no other civilised country has there been published a work of greater magnitude or intrinsic value than the celebrated "Technologische Encyclopedie" von Prechtl.

The publication of an English edition of the work before us will, we think, be hailed with pleasure, especially as the subject of technical education is now occupying prominent attention. The translator opens his preface with the following sentence:—"The several editions of Professor R. Wagner's 'Handbuch der Chemischen Technologie' have succeeded each other so rapidly that no apology is needed in offering a translation to the public." In order to give our readers some insight into the scope of this volume, we transcribe from the contents the following particulars:—*Division* I.—Chemical Metallurgy, Alloys, and preparations made and obtained from Metals—Iron; Pig or Crude Iron; Malleable, Bar, or Wrought-Iron; Steel; Iron preparations; Cobalt; Nickel; Copper; Lead; Tin; Bismuth; Zinc; Cadmium; Antimony, preparations in technical use; Arsenic; Quicksilver, or Mercury, and its preparations: Platinum; Silver; Gold; Manganese; Permanganate of Potassa; Magnesium; Electro-Metallurgy. *Division* II.—Crude Materials and Products of Chemical Industry—Carbonate of Potassa; Saltpetre; Nitrate of Potassa; Nitric Acid; Technology of the Explosive Compounds; Gunpowder, and the Chemistry of Fireworks or Pyrotechny; Nitroglycerine; Gun-Cotton; Common Salt; Manufacture of Soda; Native Soda; Soda from Plants, or Soda-Ash; Soda prepared by Chemical Processes; Preparation of Iodine and Bromine; Sulphur; Sulphurous and Hyposulphurous Acid; Manufacture of Sulphuric Acid; Sulphide of Carbon; Hydrochloric Acid and Sulphate of Soda; Bleaching-Powder and Hypochlorites; Alkalimetry; Ammonia and Ammoniacal Salts; Soap Making; Boracic Acid and Borax Production of Alum, Sulphates of Alumina, and Aluminates; Ultramarine. *Division* III.—Technology of Glass, Ceramic Ware, Gypsum, Lime and Mortar—Glass Manufacture; Ceramic or Earthenware Manufacture (1) Hard Porcelain, (2) Tender Porcelain, (3) Stoneware (4) Fayence Ware, (5) Common Pottery, (6) Brick and Tile Making; Lime and Lime Burning; Mortar: (A) Common or Air-Setting Mortar, (B) Hydraulic Mortar; Gypsum and its preparation. *Division* IV.—Vegetable Fibre and their Technical Application—The Technology of Vegetable Fibre; Flax; Hemp; Cotton; Paper Making (A) Hand Paper, (B) Machine Paper, (C) Pasteboard and other Paper; Starch; Sugar Manufacture; Cane Sugar Beet-Root Sugar; Grape Sugar; Fermentation; Wine Making; Beer Brewing; Distillation of Spirits: (A) Preparation of a Vinous Mash, (B) Distillation of the Vinous Mash; Bread Baking; The Manufacture of Vinegar: (A) Preparation of Vinegar from Alcoholic Fluids, (B) Preparation of Vinegar from Wood Vinegar; The Preservation of Wood; Tobacco; Technology of the Essential Oils, Resins, and Caoutchouc Substances; Cements, Lutes, and Putty. *Division* V.—Animal Substances and their Industrial Application—Woollen Industry; Silk; Tanning: (1) Red or Bark Tanning, (2) Tawing, (3) Samian or Oil-Tawing Process; Glue Boiling; Manufacture of Phosphorus; Requisites for Producing Fire; Animal Charcoal; Milk; Meat. *Division* VI.—Dyeing and Calico-Printing—On Dyeing and Printing in General: (1) Aniline Colours, (2) Carbolic Acid Colours, (3) Naphthaline Pigments, (4) Anthracen Pigments, (5) Pigments from Cinchonine; Red Pigments occuring in Plants and Animals; Blue Dye Materials; Yellow Dyes; Bleaching; Dyeing of Spun Yarn and Woven Textile Fabrics; The Printing of Woven Fabrics. *Division* VII.—The Materials and Apparatus for Producing Artificial Light—Artificial Illumination in General: (1) Artificial Light from Candles, (2) Illumination by means of Lamps, (3) Gas, Paraffin, and Solar or Petroleum Oils. *Division* VIII.—Fuel and Heating Apparatus—Fuel in General; Wood; Peat; Carbonised Peat; Brown-Coal; Pit Coal, or Coal; Petroleum as Fuel; Coke; Artificial Fuel; Gaseous Fuel; Heating Apparatus; Heating Dwelling-Houses; Steam-Boiler Heating and Consumption of Smoke.

This is a mere outline of the subject-matter treated of in this work. It should be borne in mind that the book, to which valuable additions have been made, is intended to be a class-book and a guide to both students and teachers of technology; but manufacturers, merchants, and scientific and practical chemists, will meet with valuable information, while for more extensive details the larger work of Dr. Wagner which consists of five volumes in the German language may be consulted. We sincerely hope that the study of technology may soon become in this country, as it already is in Germany, an important branch of education in our universities and colleges.

Second Annual Report of the Deputy Master of the Mint 1871. Presented to both Houses of Parliament by command of Her Majesty. London: Eyre and Spottiswoode. 1872.

At the close of the year 1870, the Assay Department of the Mint underwent reorganisation, the new arrangement involving the abolition of the offices of non-resident assayers, and a return to the ancient system under which all bars when alloyed and ready for coinage are assayed within the Mint itself. To render possible the exercise of a more direct and efficient control over many details upon which the accuracy of coining in a great measure depends, a second Assay Office has been established, and materially contributes to a more rapid execution of the coinage. The advantages of the change are abundant

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shown in the memorandum of Mr. W. Chandler Roberts, the Assayer, annexed to the report of the Deputy Master.

The last year presented some severe attacks upon the resources of the various departments of the Mint, for whereas the yearly average of the coinage of gold is £5,000,000, the demand for gold coin rose to the extraordinary amount of £9,798,735 for British coins alone. This enormous increase has been met with more than average success under the disadvantage of new arrangements, while several points have been gained of material value in the improvement of the gold coinage. For instance, "in the process of annealing additional experience has been acquired as to the manner in which all discolouration of the blanks by the oxidising action of the air may best be avoided, and the result has been an increased brilliancy on the surface of the coins, which contrasts not unfavourably with the hue of pieces to which the operation of blanching has been applied."

The operations of "minting" are far from being of an entirely mechanical nature, for the mechanical processes must be considered as subsidiary to the formation of an alloy of base and precious metals in definite proportions. Moreover the composition of the alloy after melting must be ascertained with the utmost accuracy, and again when the alloy has been converted into coin. Mr. Chandler Roberts has in consequence of these requirements introduced into the New Office the volumetrical method of assaying silver, and the result under his careful management, has in every detail been satisfactory. Mr. Roberts also has found that modern improvements in the process of refining having rendered it possible to extract with profit all the gold in excess of 2 grains in the lb. troy, made experiments to ascertain whether the gold was present in sufficient quantity to render desirable its extraction from the old silver coin now in course of withdrawal from circulation. The results have shown that half-crowns issued during the period between the years 1760 and 1837, contain 4·07 grains of gold in the lb. troy. Accordingly arrangements have been entered into with Messrs. Johnson and Matthey to effect the extraction.

Mr. Roberts's researches on the best method of treating "brittle" gold are very valuable, and we quote the memorandum *in extenso*. "In my preliminary reports upon the method of toughening brittle gold, dated November 19, 1869, and April 20, 1870, respectively, I detailed the experiments which enabled me to recommend that chlorine gas should be employed for rendering ductile gold of which the intractable character had escaped detection when the ingots were imported into the Mint.

"The amount of gold set aside as unfit for working during the coinage of £6,500,000, which was completed in July, 1871, amounted to 40,000 ozs., and I now proceed to describe the method by which this gold was treated; but as the details are necessarily technical, it may be well to repeat that brittleness in gold is usually due to the presence of minute traces of foreign metals, and that these metallic impurities are eliminated as chlorides by the passage of chlorine gas through the molten metal.

"In the melting of gold, as ordinarily practised in the Mint, crucibles of graphite are employed, but such crucibles are not well adapted for use in the treatment of gold by chlorine gas, as the gases evolved from them exercise a reducing action upon the chlorides. It is therefore advisable to substitute crucibles of fire-clay for those of graphite, but, as the workmen of the Mint are unaccustomed to the manipulation of fire-clay crucibles, I was obliged to avail myself of the crucibles ordinarily in use, with the slight inconvenience entailed by the necessity of prolonging by some minutes the time during which the gold is exposed to the action of the chlorine.

"About 1100 ozs. of gold were melted in each crucible, and the chlorine gas was passed through each in succession, the time during which the metal was exposed to the [illegible] from 5 to 7 minutes. The gold was found to [illegible]ough, and was re-assayed and again melted [illegible] of copper required to form standard gold.

"I append a statement indicating the result of the operations upon 40,000 ozs. of standard gold.

	Ozs.	Ozs.
Amount of initial loss		40·360
Amount of gold recovered from ground up crucibles, borax, &c.	15·507	
Amount of copper and base metal proved by assay to have been eliminated as chloride.	24·746	
		40·253
Loss		0·107

It will be seen that the loss of gold on toughening 40,000 ozs. was only 1-10th of an ounce, and I submit that the experience gained by operating upon an extended scale has fully justified the opinion which I formed from preliminary experiments, and that the process may now be considered to have fairly taken its place as an operation of minting."

The result of these carefully conducted processes is that when during the last trial the jury selected coins. assaying portions of metal from every part of the coin, their verdict was in the highest degree satisfactory, not, withstanding the increased stringency of the examination.

It is interesting as indicating the accuracy attained in the preparation of the gold-copper alloy, that analysis of the assay reports on 1,000,000 of gold coin issued in the ordinary course between the 2nd and 18th of November, 1871, shows that:—

		Per mille of Gold.
1·33	per cent of the coins contained	916·2
6·00	,, ,, ,,	916·3
6·66	,, ,, ,,	916·4
16·66	,, ,, ,,	916·5
15·33	,, ,, ,,	916·6
27·33	were of the exact standard.	916·666
13·33	,, ,, ,,	916·7
9·33	,, ,, ,,	916·8
2·66	,, ,, ,,	916·9
1·35	,, ,, ,,	917·0
99·99		

Mean composition of the coins { 916·61 gold. 83·39 copper.

1000·00

The limits of the "remedy" permitted by law being 914·6, and 918·6 parts in 1000.

These results are not only good, they are remarkable; for according to ordinary methods of chemical analysis, the deviation from the standard would only amount to a variation of 0·2 per cent, fully in agreement with the remarks of M. Le Jacobi, who represented the Russian Government at the International Monetary Conference held in Paris in June, 1867, and who said, "the tolerance is not an arbitrary stipulation, but is the limit of errors which belongs to every thought, to every chemical analysis, to every composition of alloy, and, as such, depends on the precision of the balances, and the methods employed in the fabrication of money; it may be determined rigorously by applying the calculus of probabilities."

This observation has been borne in mind by Mr. Roberts throughout the important improvements he has effected in the chemical processes pertaining to minting, the consequence being the attainment of an almost unsurpassable standard of accuracy in the composition of the coinage now in circulation.

It may not be uninteresting to shortly sketch the history of the office with which Mr. Roberts is so ably connected. According to Lowndes, the office of "miles argentarius," or assayer of silver, was established in 1180; and in 1222 the office of King's Assayer, whose report was a guarantee to the Crown and to the public of the fineness of the coin, and who was originally also the Warden of the Mint. During the

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period between 1544 and 1571 the operations of minting were performed by contract; and it was not until 1851 that the contract system was entirely abolished, and with it the office of King's Assayer, the verification of the coinage being entrusted to eminent chemists having no office in the Mint. The inconvenience of this arrangement led to the re-establishment of an Assay office for verification, and we think that our readers generally will concur with us in thanking Mr. Roberts for the diligence and care he has bestowed upon this department.

CORRESPONDENCE.

PROPOSED ASSOCIATION OF MANUFACTURING CHEMISTS.

To the Editor of the Chemical News.

SIR,—I, with your other correspondents, was pleased to see "Frank's" suggestion for an Association of Manufacturing Chemists, and your favourable remarks on same. There is no doubt such an association is wanted, and if formed, and well conducted, would be invaluable to manufacturers, and might be the means of saving thousands of pounds spent in useless experimental plant. As the provincial chemical societies, however, are, to a great extent, occupied with technical chemistry (though they do not meet the want), and do not show any remarkable signs of vitality, I am only afraid that another, and independent society, might fall into the same lethargic condition. To avoid this, I would suggest the amalgamation of all, or as many as possible, of the existing societies, such as the Chemical Societies, Association of Gas Managers, Alkali Association, &c. Of course the combination formed therefrom would require to take in a very large field, but it would be all the more likely, in my humble opinion, to flourish. With your correspondent Mr. Wilkins, I hope that the Association, if formed, will take in as members those gentlemen of the engineering profession who give a portion of their time to the study of chemical plant. For my part, and as a manager of chemical works, I think a knowledge of engineering quite as essential as a knowledge of chemistry for all those who superintend chemical works. Besides, this has been hitherto so disregarded that I am sure there might be a very great saving in the cost of all chemical plant. And why should we not be able, after a time, if the Association lived and flourished, to start some form of college devoted to the study of the principal things required in the conducting of chemical works?

In conclusion, I will only say a word or two in confirmation of what Mr. Hart says about the narrow-minded policy of secrecy amongst manufacturers dying out. Such is clearly the case, and all are willing to give others the benefit of their experiences, if there is a proper and legitimate medium for doing so. As an example, I may refer you to the two most valuable papers read by Mr. Gibbs before the Newcastle Chemical Society, and published in the *Transactions*, which I see you have had sent you. If one united Society can be formed to take in all branches (even to wages questions) of manufacturing chemistry, I feel sure it will be well supported; but establish another half and half affair only, and I fear it will never do much. —I am, &c.,

BLACK ASH.

[Since the publication of "Frank's" letter and our article on this subject, several correspondents have offered their assistance in the formation of the proposed Association, and letters containing many practical suggestions have appeared in our columns. We are informed that steps have been taken at Newcastle-on-Tyne to organise the Society, and we hope shortly to record the success of the preliminaries.—ED. C. N.]

TESTING BLEACHING POWDER.

To the Editor of the Chemical News.

SIR,—I have found it very convenient, in the determination of chlorine in hypochlorite of lime (bleaching-powder), to use an *acid* normal solution of ferrous sulphate, and attach to the bottle, by a copper wire, a rod of zinc, which is immersed in the solution before using it, and reduces the ferric sulphate, that has been formed by the action of the air, to its pristine condition. In this way I believe a normal solution might be used for years. Of course it can be used equally well for the titration of any other oxidising agent, like permanganate of potash or bichromate of potash.

Hoping that this simple suggestion may be of use to some of your readers,—I am, &c.,

S. CABOT, Jun.

Merrimack Print Works,
Lowell, Massachusetts.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

American Journal of Pharmacy, July, 1872.

In addition to several important original papers relating more particularly to pharmacy and pharmacognosy, this number contains the following original papers and essays bearing upon chemistry:—

Cotton-Root.—Dr. E. S. Wayne.—This memoir contains the account of researches made with the root of the cotton plant (*Gossypium herbaceum*), which is used medicinally in some portions of the United States as an emmenagogue, parturient, and abortive, and is said to promote uterine contractions with as much efficiency and more safety than ergot (*Secale cornutum*). The author ascertained that it contained no propylamine or such alkaloids as ergotina and ecbolia, but a red-coloured resinous body was found, which is insoluble in alcohol, chloroform, ether, and liquid ammonia, but is soluble in solutions of caustic potassa and soda. This substance, which appears to be due to the rapid oxidation of a body met with in all parts of the plant, is termed by the author gossypic acid. The author incidentally mentions that cotton-seed cake (the mass left after pressing the oil out) contains more or less of this resin, and that if cows are fed upon it abortion is produced.

On Lobelina.—W. D. Richardson.—The alkaloid just named exhibits a light yellowish colour, and has a somewhat aromatic odour. It is specifically lighter than water, in which it is soluble; this solution has an extremely acrid taste; it turns turmeric-paper brown, and red litmus-paper blue. The alkaloid neutralises acids, and forms crystallisable salts, which are soluble in water, less so in alcohol, and sparingly in ether; the acetate of lobelina does not crystallise. One of the most interesting properties of this alkaloid is its decomposition by the aid of heat, either in the free state or as it exists in the herb; it is combined with lobelic acid in the herb and seeds. Boiling water is sufficient to deprive it of its characteristic acrid taste; on being combined with strong acids, lobelina is not so affected by heat, but on being simply exposed to air it undergoes a change, whereby it is rendered incapable of uniting with acids to form salts. The mode of preparation is described at great length.

Valuable Products Obtained from the Maclura Aurantiaca, Texan.—The author states the extract of the wood of this tree (a native of Northern Texas, locally known as Bois d'Arc and Osage orange, and cultivated for the purpose of forming hedges) yields with water a decoction used as a yellow dye, while the inspissated aqueous decoction is of such a beautiful yellow colour that it might be properly called aurantine. In addition to this colouring matter, the Bois d'Arc contains a large percentage of tannin; experiments made in Texas prove that hides are tanned much quicker with the wood of this tree than with oak-bark. The seeds from the fruit yield a bland limpid oil, which is used for burning in lamps and also for culinary purposes; this oil resembles olive oil in taste, and it maintains its fluidity at a low temperature.

Notes on American Asphaltum.—Dr. J. S. Newberry.—This essay treats, in the first place, on the origin of asphaltes, the opinion of the author being that all asphaltes are more or less perfectly-solidified residual products of the spontaneous evaporation of petroleum.

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The chief asphalte deposits of North America (including Canada, New Brunswick, and California) are then briefly described. It appears that asphalte is found in large quantities and in different stages of formation, its origin from petroleum being very plainly exhibited in South California, where the accumulations of asphalte on the coast of Santa Barbara, San Luis Obispo, and other localities, have attracted the notice of all travellers visiting that region. When the asphalte drips from the cliffs, and forms a scum on the ocean off the coast, it is evaporated and oxidised, and then thrown upon the beach by the waves. In the neighbourhood of Chicago, Ill., the limestone formation is in some places saturated with a thick petroleum, which, on exposure to air, is converted into asphalte. At the conclusion of his paper the author says that, notwithstanding the large quantity of asphalte met with in the country alluded to, for practical purposes it will be cheaper and more convenient to bring the Trinidad asphalte to America, because the transport and working of the asphalte found there will be too expensive, and the quantity found in the island of Trinidad (a British colonial possession) is inexhaustible.

The Chili-Saltpetre (Nitrate of Soda) Deposits of Peru.—Dr. J. M. Maisch.—It appears that, in many localities of Peru, not only strata of nitrate of soda, but also of borax and other salts, are found, while occasionally a more or less thick stratum of guano is met with between the layers of salt. The mother-liquors left after the crude method of refining the nitrate of soda, yield large quantities of iodine.

Hydrofluoric Acid.—A. P. S. Stuart.—In order to overcome the well-known difficulty of removing from the platinum or leaden vessels the hard, compact, rock-like residue left after the mixture of fluor spar and sulphuric acid is heated for the purpose of evolving hydrofluoric acid, the author recommends to mix with the fluor spar an equal weight of gypsum and the proper quantity of sulphuric acid; the residue left, after the expulsion of the hydrofluoric acid, is then found to be of a pasty nature and is readily removed by water.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, May 19, 1872.

Testing and Verification of Alcoholometers and Areometers.—M. Collardeau-Vacher.—The first instalment of a memoir written to point out the necessity of testing the hydrometers in use for estimating the strength of alcoholic and other liquids, especially for excise purposes. There is added to this memoir a tabulated form exhibiting the density of alcohol (and mixtures of alcohol and distilled water) at 15°, and the corresponding alcoholometric degrees of Gay-Lussac's hydrometer.

Oxyhydrogen Blowpipe.—M. Wiesnegg.—The description, illustrated by woodcuts, of apparatus suitable for smelting substances such as platinum, iridium, and other very difficultly fusible minerals.

Tinning with Zinc instead of Tin.—C. Mène.—The author calls attention to a fraud which, in France at least, seems to be on the increase, viz., that of using zinc instead of tin for the purpose of lining copper vessels, which are in general use for cooking purposes in France; zinc being readily acted upon by weak acids, vinegar, &c., yields poisonous compounds. In order to test the tinning, the author recommends the boiling of vinegar in the vessel; if the surface remains bright, genuine tin has been used, but, if the metallic surface becomes tarnished, zinc may be suspected to have been substituted, and further research will be required before using the vessel for cooking purposes.

Annales des Mines, No. 1, 1872.

This number contains the following original paper relating to chemistry:—

Abstract of the Chemical Analysis made at the Departmental Chemical Laboratory at Mezières.—E. Nivoit and E. Letrange.—A brief account of fourteen analyses relating to iron ores, limestones, marls, fire-clay, and a copper ore; all these minerals are chiefly of local interest, excepting a copper ore from Siegen (Province of Nassau, Prussia), the composition of which, in 100 parts, is—Hygroscopic water, 0·10; quartz, 6·60; copper pyrites, 32·32, consisting of—Copper, 11·36; iron, 9·93; sulphur, 10·83; carbonate of iron, 60·61.

Journal de Pharmacie et de Chimie, June, 1872.

This number contains the following original papers and memoirs relating to chemistry:—

Researches on the Preparation of Atropine from Belladonna Leaves (Atropa Belladonna).—J. Lefort.—From the author's researches—chiefly instituted with the view of obtaining a more advantageous method of preparing atropine for pharmaceutical purposes—it appears that the leaves of this plant contain about 4·5 grms. of the alkaloid to the kilo., and the root from 2 to 5 grms. The preparation of the atropine is described at great length, the main features of this operation being the exhaustion of the dry leaves with boiling hot water to which 10 grms. of tartaric acid to the kilo. are added. The filtered fluid is evaporated to the consistency of a soft extract, which is next treated with alcohol; the alcoholic solution is again evaporated to the consistency of an extract, which is next treated with an ethereal solution of caustic potassa, from which solution the atropine is separated by means of dilute sulphuric acid; the sulphate of atropine is lastly decomposed by means of bicarbonate of soda.

Condensed Report on Artificially-Made Butter Prepared by M. Mège-Mouries.—F. Bondet.—This lengthy memoir enters into details of scientific researches made by the first-named author, upon which he has based a method of preparing from milk and fat (oleomargarine) a substance resembling and tasting like butter, which remains sweet for five months after having been made. The mode of preparation of this imitation of butter is described at length, and the reporter comes to the conclusion that in a sanitary point of view the preparation may, if properly prepared, be used with advantage instead of genuine butter, but that the artificially-made product should be designated as such, and put into casks or vessels distinctly bearing the name and address of the maker.

Programm der Königlichen Rheinisch-Westphälischen Polytechnischen Schule zu Aachen für den Cursus 1872-3.

We owe to the courtesy of the eminent director of this establishment the opportunity of again calling attention to the Royal Rhenish Westphalian Polytechnic School, founded by the munificence of H.M. the Emperor of Germany at the ancient capital of Lower Lorraine. The programme before us—a volume of 112 large octavo pages, exclusive of two large tabulated forms—is highly valuable. It should be understood that this institution is in reality a polytechnic university, and those who desire to attend the lectures and enter as students (students in distinction from persons who are usually called "Hospitanten," *i.e.*, those who attend lectures without intending to pass examinations or to receive certificates of efficiency) should have received a sound preliminary education. The course of instruction intended to be given at the Polytechnic School at Aachen from October 7th, is described, and a loose sheet is added containing hints for those who desire to attend the instruction of a polytechnicum, as it is properly termed. The lectures and practical instruction embrace no less than sixty-one different subjects, and include not only all matters relating to mathematics, geometry, and physical sciences, pure as well as applied, but also everything required by the civil and mechanical engineer, architect, industrial and technical chemist, metallurgist, mining engineer, &c. The Polytechnic School possesses excellent libraries, laboratories, workshops, museums, and collections of various kinds, and a catalogue is given of donations during the year from different countries and private individuals (123 in number). Among the donations specially alluded to, mention is made of a complete set of Specifications of Patents, presented to this school by the Right Hon. the Commissioners of Patents for Great Britain and Ireland. Space forbids us to enter into more details; we may, however, mention that 347 persons have attended lectures during second term, including 2 ladies and 260 actual students; 215 were Prussians, 41 natives of other States of the German Empire; 11 Netherlanders, 7 Russians, 6 Belgians, 6 Luxemburgers, 3 Hungarians, 2 English, 2 Norwegians, and 1 from Bohemia, France, Poland, Galicia, Italy, and Roumania, respectively.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 235, July, 1872.

This number contains no original papers relating to chemistry, but we call attention to the following memoir:—

Metalliferous Mines of France, not including Iron Mines. A. Caillaux.—This essay contains valuable information relating to the history of the art of mining in, as well as to the mineral wealth of, France.

Report on a New Gazogene Apparatus contrived by M. Maldiné.—H. Bouilhet.—Illustrated by engravings, this paper contains the description of a greatly-improved gazogene.

Les Mondes, July 18, 1872.

Coal in Chili.—Rev. F. Moigno.—It appears that very rich seams of coal have been discovered in Chili and in localities not far distant from the seaboard.

German Society of Natural Philosophers and Physicians.—The annual meeting of this Association will be held at Leipzig from the 12th to 18th of August next.

Digitaline.—Dr. Roucher.—The author states that the result of his researches is, that the crystallised digitaline prepared by Nativelle, as well as that prepared by Homolle and Quevenne, is not an active and simple principle, but that both are very complex compounds, and that the elementary analysis of these substances is incorrect.

Saline Iodated Water of Salès.—Dr. Pietra-Santa.—This water is a native spring, situated near Alexandria (Piedmont, Italy); it is stated to possess great medicinal virtues, and to contain a large proportion of iodine.

Forests of Alsace and Lorraine.—Rev. F. Moigno.—At the time when Jules Favre was engaged in treating for peace, his attention was called to the fact that the territory alluded to contains 133,500 hectares of forest land belonging to the State, and worth at least 300,000,000 francs, and that the giving up of this estate should be considered in the sum of indemnity to be paid by France. M. Jules Favre appears to have taken no notice of the hint given him. Prussia has therefore obtained this valuable property *pardessus le marche*.

Œnotannin.—M. Maurial.—After an experience of forty years, the author recommends this preparation to wine growers for keeping wines in good and sound condition without imparting to them a bitter taste.

Bibliography.—Under this heading, attention is called to the following pamphlet:—"Simples Indications pour Propager l'Emploi de l'Engrais-Vidanges dans les Diverses Contrées de France, et Note Relative aux Engrais Vidanges de Paris." Par Maxime Paulet. 8vo., 46 pp. Paris: Lacroix, éditeur. 1872.

Phosphoric Acid and Superphosphates Manufactory.—M. Blanchard.—An account is given of the method of preparing the sub-

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stances alluded to as made at Puteaux, near Paris. In order to obtain phosphoric acid, the superphosphate (prepared from rich native phosphatic minerals) is mixed with water (1200 kilos. to 1000 kilos. of superphosphate), and this mixture put into stout linen bags and submitted to strong pressure by the aid of hydraulic presses. The liquid is collected in tanks, and next evaporated and concentrated; what remains in the bags is sold as superphosphate at 10 per cent. The lime is eliminated from the phosphoric acid-containing liquor by means of sulphuric acid, sulphate of lime being deposited by the concentration of the phosphoric acid solution.

Le Moniteur Scientifique Quesneville, No. 367, July, 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Study on the Quantitative Estimation of Phosphoric Acid in all Products of Agricultural Interest and those belonging to the Domain of Physiology.—Dr. Joulie.—The second instalment of a very complete monograph on this subject (see CHEMICAL NEWS, vol. xxv., p. 646). We regret that this excellent memoir is too long to be reproduced in full. There is added to this portion a letter from Dr. Bobierre, the celebrated agricultural chemist at Nantes, explaining his views on the memoir.

Analysis of Fossil Phosphates.—Dr. A. Bobierre.—This excellent essay, also too long for either reproduction or abstraction, winds up with the following general conclusions:—The only proper method of analysis of fossil phosphates is that whereby the phosphoric acid is separated. The commercial method of analysing bone-ash, bone-black, and similar products may be advantageously applied in many cases, provided care be taken to use pure ammonia, and also that the ammonia precipitate be not exposed too long a time to the air; this method should only be applied when agreeable to both seller and buyer.

The Eucalyptus Globulus considered from an Industrial, Hygienic, Economic, Medicinal, and Pharmaceutical Point of View.—F. Papillon.—This memoir treats at great length on a tree, native of Van Diemen's Land, or Tasmania, discovered there first on May 6th, 1792, by the French admiral, Labillardière, while in command of the *Entrecasteaux* and in search for *La Perouse*. From this essay, it appears that the cultivation of this tree, already acclimatised in Southern Europe and Algeria, may become of very great importance. The tree will not thrive in countries where the winters are rather cold. The tincture of Eucalyptus is stated to be an excellent remedy against ague and intermittent fever, especially that kind which is often endemic in marshy districts.

Improved Panification Process.—MM. Sauer and Cachal.—The authors have invented a liquid, to which the name "extract of yeast" is given, and which is so manufactured that, according to the different requirements of the baker, he can use a stronger or weaker fluid for the purpose of producing fermentation. The improvement upon the ordinary plan consists in a greater yield (from 16 to 20 per cent more) of bread, while also the production of alcohol and acetic acid (formed from the former) is prevented, and thus the gluten of the flour kept in a more sound state. The liquid alluded to is composed of some ten different ingredients.

Beet-Root Sugar Extraction.—M. Woestyn.—The description of an improved process of treating the beet-root juice, consisting mainly in precipitating, by means of a current of carbonic acid, the lime usually added in the first operation of treatment of the juice. The result is that, along with the precipitate of carbonate of lime, a great many impurities are thrown down.

Theory of the Mordanting with Alum of Woollen Goods.—P. Havrez.—This essay is divided into the following sections:—Active causes during the aluming; effects of dissociation and absorption; the alum-bath; effects of the two dissociated hydrates (viz., of alumina) upon wool—(*a*) in a quantity fifteen times larger than the weight of alum, (*b*) in by far smaller quantity; dilute sulphuric acid and wool; soluble hydrate of alumina and wool; conditions of duration (length of time), quantity, temperature, &c., which cause the increase of the dissociation and absorption of aluming; (*a*) action of the bulk of water; (*b*) action of the temperature; (*c*) action of the quantity of the wool; (*d*) action of the duration of the aluming. General conclusions:—Large quantities of mordants (salts of alumina, iron, chromium, tin, copper, &c.) act in solution as *salts* (or even as *salts* and *acids*) after having been absorbed by wool. Small doses of these mordants act upon wool as metallic hydrates, the formation of which is aided by prolonged boiling of the materials (viz., wool, water, and alum, or other salts, as the case may be). The unequal absorption by the wool of the dissociated basic hydrates and acids, and the reaction of these bodies, mutually cause these different actions; it thus appears that the excess of salt can be replaced by small quantities of acids or acid salts (of potassium, bisulphate, binoxalate, bitartrate, &c.), which become converted, in the water, into acid and neutral salt. The increase of metallic hydrate fixed is due to the addition of *water*, the application of heat, and the prolonged keeping of the wool in the bath. The colour which the wool assumes in the dyebeck reacts chiefly upon the first portions of acid hydrate and basic hydrate absorbed by the wool. The acid has a purifying action, and appears also to promote the liberation of the glucose colours (thus forming carmine-red from carmine), while the metallic hydrate fixes upon the wool the variously-coloured lakes.

Bulletin de la Société Chimique de Paris, Vol. xvii., No. 10, May 15, 1872.

This number contains the following original papers and memoirs:—

Action of Water and Heat, or of Heat only, upon Sugar.—E. J. Maumené.—200 grms. of sugar and 1000 grms. of water have been kept for some twenty-eight hours at the temperature of boilin water; the optical rotatory power of the sugar has then quite dis appeared. Sugar and water have been enclosed in sealed tubes an kept for about thirty days at the temperature of boiling water, wit the result that the sugar had become entirely converted into an un crystallisabie compound, probably identical with that which Berzeliu and Gelis have obtained by rapidly heating sugar to 160°. By heatin sugar for eight days consecutively in sealed tubes in steam of 5 atmo spheres pressure (75 lbs. to the square inch, and 153° C.), the sugar i converted chiefly into carameline, $C_{12}H_8O_8$. In conclusion, th author states that sugar, while being refined or extracted on the larg scale, should never be submitted to a higher temperature than 75 because below that degree of heat sugar is not perceptibly altered.

Action of Crystallised Digitaline upon the Combustio (Act of Respiration of the Lungs) and upon Diuresis.—A Mégevand and G. Daremberg.—This paper, elucidated by a numbe of tabulated forms exhibiting the results of experiments, details th observations of the effects of the digitaline alluded to upon the authors, who partook of doses amounting to from one-fifth to one-half milligramme.

Vol. 17, No. 11, June 1, 1872.

Detection of Counterfeited Kirschwasser.—Dr. Bouis.—According to the author, tincture of guaiacum produces, in genuine Kirschwasser (a very strong alcoholic liquor prepared in some parts of Switzerland from a peculiar kind of cherries, which are bruised and crushed along with the stones, then fermented and distilled), a blue colour; but not so in the kirschwasser prepared simply by adding *aqua lauro-cerasi* to spirits. This blue colouration is, according to the author, due to traces of copper, which are found in the genuine spirit, and which gives a blue colour to the tincture in the presence of cyanhydric acid (always present in the genuine kirschwasser).

Memoir on a New Series of Platinic Compounds.—Dr. P. Schützenberger and M. Fontaine.—The first instalment of an extensive monograph, elucidated by a very large number of lengthy and complex formulæ, and divided into the following sections:—Introduction, containing an *expose* of the principal facts studied in this memoir; phospho-platinous chloride, $PhCl_3Pt = PhCl_2.PtCl_2$; phospho-platinic chloride, $(Ph_3Cl_6PtCl_2)$; phospho-platinous acid, $Ph(HO)_3PtCl_2$.

Oxidation of the Acetons of Phenyl-Acetic Acid.—M. Popoff. —This memoir, elucidated by a series of formulæ, treats on methyl-benzylic aceton and on ethyl-benzylic aceton.

NOTES AND QUERIES.

Amalgams.—During some recent experiments on amalgams, made with dry filings and mercury, with the object of obtaining one free from shrinkage, I find a law which apparently holds good in all cases, viz., that any alloy which when reduced to filings will harden when mixed with mercury, without shrinkage, is also free from shrinkage when cast. An alloy containing gold, platinum, silver, and tin, if poured at a clear red-heat into a warm iron mould, remains perfectly rigid, and cannot be removed from the mould without considerable force. If this alloy, in filings, is mixed with about 15 to 17 per cent of mercury, and pressed into a solid mass into a mould, it remains tight in its place, without shrinkage, after it has become as hard as good brass, and continued heavy pressure will not force a trace of a coloured solution between the mould and the plug of amalgam. Whether this law holds good with every alloy I cannot say, but it evidently does so with a great many of similar composition to the one mentioned.—THOS. FLETCHER, F.C.S., 15, Bold Street Warrington.

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THE CHEMICAL NEWS.

Vol. XXV. No. 662.

ON THE

LAW OF EXTRAORDINARY REFRACTION IN ICELAND SPAR.*

By G. G. STOKES, M.A., Sec. R.S.

It is now some years since I carried out, in the case of Iceland spar, the method of examination of the law of refraction which I described in my report on Double Refraction, published in the "Report of the British Association for the year 1862." † A prism, approximately right-angled isosceles, was cut in such a direction as to admit of scrutiny, across the two acute angles, in directions comprising respectively inclinations of 90° and 45° to the axis. The directions of the cut faces were referred by reflection to the cleavage planes, and thereby to the axis. The light observed was the bright D of a soda-flame.

The result obtained was, that Huyghens's construction gives the true law of double refraction within the limits of errors of observation. The error, if any, could hardly exceed a unit in the *fourth* place of decimals of the index, or reciprocal of the wave-velocity, the velocity in air being taken as unity. This result is sufficient *absolutely to disprove* the law resulting from the theory which makes double refraction depend on a difference of inertia in different directions.

I intend to present to the Royal Society a detailed account of the observations, but in the mean time the publication of this preliminary notice of the result obtained may possibly be useful to those engaged in the theory of double refraction.

ELECTROSCOPE PHENOMENON.

Professor Forster, in a recent number of *Poggendorff's Annalen*, gives an account of a curious effect observed in a gold leaf electroscope. He was one day showing to an audience, that if the leaves were in a state of divergence through negative electricity, the divergence would be increased on approach of a *negatively* electrified body, and that it would be diminished in the opposite case.

To prove this, he had a magnified image of the leaves projected on a screen. He rubbed a rod of caoutchouc with catskin, and touched with it the ball of the electroscope. On removing the rod, the leaves showed about 70° divergence. He again rubbed the rod, and brought it from above towards the electroscope, the axis of the former being at right angles to the vertical axis of the latter. Expecting the divergence to increase, he was surprised to find that it diminished, and on further approach became zero; while it increased on slightly removing the rod. If the rod was withdrawn very slowly, the divergence remained zero, but rose again to the former amount as the rod was further withdrawn. Frequent repetition of the experiment gave similar results; only, he remarks, the electrical source must be a pretty powerful one.

After various futile attempts to explain the matter, there arose the doubt whether the divergence which appears after making a rubbed caoutchouc rod touch the ball of the electroscope was really due to negative electricity (−E). He became convinced that, while the rod is, of course, negatively electrified, yet the leaves diverge with positive electricity (+E).

He thus describes his experiments:—"Let a caoutchouc rod be rubbed with catskin and brought near the knob of a Fechner electroscope" (in which, it may be explained, there is only one leaf suspended between the opposite poles of a pile). "The leaf then moves to the + pole. The rod is therefore − electrified. Now rub the rod again, and touch with it the knob of the gold leaf electroscope" (with two leaves). "Then remove the rod. Next, let the knob of this charged electroscope be brought near the knob of a Fechner electroscope (uncharged). The leaf of the latter moves to the − pole; the leaves of the former, therefore, diverged with + E; and thus the electroscope became +electrified through contact with the −electrified rod.

"It remained to ascertain the reason of this fact, which, once ascertained as a fact, removed the difficulty in the first experiment.

"When the strongly −electrified rod is brought near the knob, there takes place decomposition of the electricity in the electroscope. The + E flows into the knob, in which it is retained by the rod; the −E flows into the leaves, which diverge in consequence. While thus influenced by the rod, −E escapes, and there is a progressive collection and retention of +E in the knob. At the moment of contact between knob and rod, the rod communicates the −E, present at its point of contact, to the knob, and this neutralises in the latter a corresponding quantity of +E.

As, however, the excited parts of the rod not in immediate contact with the knob do not give up their −E, this surplus of −E still carries on the decomposition and retention of electricity in the electroscope; so that there comes to be much more retained +E in the knob than −E in the leaves (for a constant waste of −E takes place in the electroscope). If the rod is now slowly removed, its retentive influence on the knob decreases, and a certain quantity of +E flows into the leaves, neutralising there a certain quantity of −E. When the rod is just so far removed that as much +E can flow from the knob into the leaves as there is −E in these, the leaves become unelectrified and the divergence zero. On further withdrawal, still more of the hitherto retained +E flows from the knob to the leaves, and now commences a divergence with +E. When the rod is entirely removed, the whole of the hitherto retained +E is free and produces strong divergence. As the rod is approached again, these phenomena are witnessed in reverse order.

"This theory rests on the supposition that the +E which has been separated and retained by the rod preponderates over the −E communicated to the electroscope by contact (which is easily understood, as an electrified non-conductor gives up its electricity only at the point of contact). For this preponderance to take place, it is necessary, as has been said, that the electric source should be a very active one.

"It can, further, be easily shown that in such circumstances the −E flows away from the electroscope (without conduction) if the electrified rod be brought near the knob without touching it. In this case no electricity can flow directly from the rod to the knob, and yet, if after a few seconds the rod be withdrawn, the leaves diverge considerably with +E. The explanation is simple.

"The fact, however, that it is possible, by contact of the electroscope with a negatively electrified body, to obtain +divergence, appears to me one of considerable importance.

"Thus, supposing, in the absence of a pile electroscope, it were required to determine whether a body rubbed with a certain kind of material became + or − electrified, it would be a very likely method to first cause divergence in the electroscope leaves with a rubbed caoutchouc rod, and then test the electric state of the body in question by its influence on the divergent leaves, and call it + or − accordingly. On the former supposition, that the leaves diverged with electricity of the same sign as the caoutchouc rod, any such judgment would be absolutely false. A + electrified body would be taken for a −, and *vice versâ*.

* A Paper read before the Royal Society.
See p. 270.

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"Such error might be guarded against if, instead of bringing the caoutchouc rod near the electroscope, a small charge of $-E$ were brought from the former, by means of a proof plane, to the knob of the latter, as the proof plane would not collect sufficient electricity to produce the disturbance observed in the other case."

A. B. M.

ON A NEW SULPHATE OF COPPER VOLTAIC ELEMENT,

ARRANGED WITH THE VIEW OF THE

APPLICATION OF CONTINUOUS CURRENTS TO THERAPEUTIC PURPOSES.

By M. J. MORIN.

This new element has for its object the complete avoidance of the inconvenience which results, in the ordinary sulphate of copper element, from the deposit of zinc either on the copper or the porous cell. It consists of a cylinder of copper, the interior of which is concentric with the cylinder of zinc; the annular space comprised between these two metallic surfaces is divided into two equal parts by a cylinder of filter-paper. Ordinary sandstone is put between the interior surface of the copper and the paper diaphragm, and sublimed sulphur on the side of the zinc; the whole is plunged in a solution of sulphate of copper, which penetrates through the mass by means of the numerous minute orifices freely to the copper.

Some hundred elements prepared in this manner, and frequently in use, have been set up for more than twenty months, and the alteration which they have undergone shows that this is but half the time for which they may be worked; they have been perfectly closed during this time, and have neither been subjected to repair or inspection.—*Comptes Rendus.*

ON THE ESTIMATION OF CITRIC ACID, FREE AND COMBINED,

AND ON A

NEW SERIES OF COMPOUND CITRATES.

By J. CREUSE, of Brooklyn, N.Y.

Having undertaken the study of the citrates as a class, and especially of those of the citrates in which the acid is combined with more than one base, the first difficulty I met was how to determine citric acid without having recourse to the long and complicated process of an organic elementary analysis. I consulted the most recent publications and some eminent chemists without obtaining my desideratum, viz., how to determine citric acid, free and combined, in the same direct manner as sulphuric or muriatic acid. Then the only thing left for me was to try myself and find such a process, in which I succeeded, after many failures, including an explosion of citrate of silver.

As this process may be interesting and useful, I will describe it here.

It is founded on the fact, that, while the alkaline citrates, the alkaline acetates, and the acetate of baryta are freely soluble in alcohol, sp. gr. 0·908 (63° Gay-Lussac), citrate of baryta is completely insoluble in that menstruum, and, when the reagents are neutral, is always precipitated by double decomposition in the shape of the neutral citrate, $3BaO,C_{12}H_5O_{11}$, with a variable equivalent of water.

As the presence of alkaline or barium acetates does *not interfere* with the reaction, this enables the chemist to determine citric acid in almost any shape; for fr citric acid may be saturated with an alkali, alkali citrates may be analysed directly, and other citrates m be decomposed by an excess of caustic potassa, the exce of alkali being neutralised by acetic acid.

This method, presenting some peculiar features, requir to be explained in full.

If the citric acid to be estimated is in the shape of a alkaline citrate, take from 1 to 2 grms. of the salt an dissolve in 10 to 20 c.c. of distilled water; neutralis the solution with acetic acid if it is alkaline, with ammo nia if acid; then add a slight excess of a neutral solutio of acetate of baryta and twice the volume of the whol liquid of alcohol 95 per cent; allow to rest for from 12 t 24 hours. The citrate of baryta, which was at first i the shape of a thick jelly, will have become, by that time, denser and easier to wash. Transfer the whole to a suitable filter; as some of the citrate of baryta always adheres to the sides of the vessel where the precipitation has been effected, it is recovered thus:—Pour into the vessel 10 to 15 c.c. distilled water, turn it around so as to wet all the places where any of the salt is left adhering; citrate of baryta, being to a certain extent soluble in water, is soon taken up by the liquid; then add to it double its volume of alcohol 95 per cent, and pour on the filter with the first product. This being repeated a second time, all the citrate of baryta may be considered as collected on the filter. Wash this thoroughly with alcohol 63 per cent, and dry at a moderate heat. The precipitate thus obtained contains *all* the citric acid of the citrate in the form of citrate of baryta; but this salt is too hygroscopic to give correct results if weighed directly. It is necessary to transform it into sulphate of baryta. This is done without difficulty, by burning the filter and heating the ashes and precipitate with sulphuric acid several times, till a constant weight is obtained. The weight of the sulphate of baryta is then noted, and from this the weight of the citric acid may be calculated within 2 or 3 milligrammes.

If free citric acid is to be estimated, a convenient quantity may be first saturated with a titrated solution of caustic soda, which gives usually a little more than the actual strength; the citrate of soda may be then treated in the manner described above, which gives a result a little below the truth, and the average between the two results will be within 1 or 2 milligrammes of the truth.

If it is proposed to estimate the citric acid of a citrate of bases other than the alkalies, soluble or otherwise, the operation is to be conducted in this manner:—

A certain quantity of the salt, from 1·50 to 2·50 grms., is heated carefully with a solution of caustic soda or potassa in excess; the heat must be applied long enough to precipitate the base thoroughly, but not enough to alter the citric acid into aconitic, oxalic, or any other derivative; the liquid is then filtered as usual, and exactly saturated with acetic acid; after which it is treated as an ordinary alkaline citrate. For obvious reasons the saturation must be as perfect as possible.

The solution of acetate of baryta used for these precipitations may be prepared by saturating pure acetic acid diluted, with an excess of carbonate of baryta, heated to ebullition, adding some alcohol when cold, and filtering. This solution may be titered so as to contain a certain percentage of baryta, say 5 per cent, in order to facilitate its use. The addition of alcohol insures its keeping unchanged for an unlimited period.

I am aware that none of these methods can be applied to the estimation of citric acid in those citrates the base of which is soluble in alkalies. These require a peculiar modification, of which I intend to treat another time.

As illustrations, I will describe a few analyses performed by my method.

Estimation of Free Citric Acid.

A certain quantity of crystallised citric acid containing 4 equivalents of water, unknown to me, was weighed at

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my request by a friend, and dissolved in 10 c.c. of distilled water. A titrated solution of caustic soda, added till saturation, indicated 0·877 of citric acid. The neutral citrate of soda thus obtained was treated in the manner above mentioned by acetate of baryta; the citrate of baryta was transformed into sulphate, and this salt repeatedly ignited was ascertained to weigh 1·518 grms.

To calculate from this the weight of citric acid we establish the proportion—

$$201 : 349{\cdot}5 = 1{\cdot}518 : x$$

$$\text{or } \log. x = \log. 201 + \log. 1{\cdot}518 - \log. 349{\cdot}5$$

$$x = 0{\cdot}873$$

The average between the two valuations would be 0·875. The actual weight of the citric acid had been 0·875 grms.

Analysis of Citrate of Bismuth.

This citrate of bismuth is the salt obtained by precipitating acid nitrate of bismuth by a neutral alkaline citrate. It is insoluble in water, and may be obtained pure without difficulty.

Two grms. of this salt were taken, suspended in water, and decomposed by an excess of caustic potassa at a moderate heat, slowly increased till the boiling-point was reached. The precipitate of anhydrous teroxide of bismuth, well washed and dried, was found to weigh 1·122 grms. The washings were collected together, saturated with acetic acid, treated by acetate of baryta and alcohol, as already mentioned, and the citrate of baryta, thus separated, yielded 1·674 grms. of sulphate, which corresponds to 0·790 of citric acid. The balance 0·09 represents the equivalents of water and the loss. Hence we may figure the result thus:—

Teroxide of bismuth ..	1·122	1 equivalent.
Citric acid	0·790	1 ,,
Water	0·086	2 ,,
Loss	0·002	
	2·000	

Or in other figures—

Teroxide of bismuth ..	232
Citric acid	165
Water	18
	415

From this, I think the formula of the insoluble citrate of bismuth may be safely said to be—

$$BiO_3,C_{12}H_5O_{11}+2HO=415.$$

Double Citrate of Bismuth and Ammonia.

This combination is obtained in two forms—in solution and in scales. In solution it may be either acid, alkaline, or neutral; in scales it is always acid, on account of the loss of some ammonia during evaporation. It is very extensively used in medicine; unfortunately its solution is rather unstable.

The analysis of this salt presented no difficulty: 2·085 grms. of the insoluble citrate of bismuth were weighed in a small porcelain dish, a little warm water added, and a small piece of litmus-paper allowed to float on it. Then a titrated solution of ammonia, containing 0·26 grm. of ammonia to the 100 measures, was cautiously added, the mixture being stirred all the time. As the last drops of the 100 measures fell into the porcelain dish, the litmus-paper, red until then, turned blue, and at the same time the liquid became perfectly clear. Thus by synthesis this gives for the neutral citrate of bismuth and ammonia the following formula:—$2NH_3,BiO_3,C_{12}H_5O_{11}+nHO$. That is, two equivalents of ammonia, and one of bismuth teroxide saturating one equivalent of citric acid, the proportion of water being undetermined.

The analysis of the salt in scales was effected thus:—2·302 grms. of the ammonio-citrate of bismuth in scales (as it is commonly called) were dissolved in a little warm water, and a small piece of blue litmus-paper was made to float on it. The litmus-paper turned red immediately. Then, the same titrated solution of ammonia already mentioned was added carefully till saturation. Of this, 25 measures were necessary, corresponding to ½ equivalent. This demonstrated already that the quantity of ammonia contained in the salt was 1½ equivalents.

The liquid was then decomposed by caustic potassa in excess, and the operation conducted precisely in the manner described for the analysis of citrate of bismuth. The following numbers were obtained:—

Teroxide of bismuth	1·170
Citric acid	0·823

The quantity of ammonia being already known, the compound may be re-constructed thus:—

Teroxide of bismuth ..	1·170	1 equivalent.
Citric acid	0·823	1 ,,
Ammonia	0·122	1½ ,,
Water	0·180	4 ,,
Loss	0·007	
	2·302	

Or, in chemical symbols—

$$1\tfrac{1}{2}(NH_3),BiO_3,C_{12}H_5O_{11}+4HO=458{\cdot}5.$$

I must say that in this salt I believe the proportion of ammonia may vary slightly, according to the mode of evaporation; it cannot fall below 1½ equivalents, however, without causing a decomposition of the salt.

Analysis of the Double Citrates of Bismuth and Potassa, Soda, and Lithia.

I believe these combinations have neither been mentioned nor obtained yet by any body. Besides their interest in a chemical point of view, I think they will become of some importance in medicine, on account of their greater stability compared to the analogous ammonia salt. Of this I will treat another time.

The potassic and sodic citrates of bismuth are obtained easily by adding 2 equivalents of the caustic alkalies to 1 equivalent of the simple citrate of bismuth suspended in water, moderate heat being applied. They require, however, a little more care than the corresponding ammoniacal combination; for any excess of soda or potassa is liable to precipitate some of the metallic oxide, a decomposition which ammonia will not cause under any circumstances.

The double citrate of bismuth and lithia is prepared by adding 2 equivalents of carbonate of lithia to 1 equivalent of the simple citrate of bismuth, heat also being applied.

The following are the formulæ of these double citrates:—

$$2KO,\ BiO_3.C_{12}H_5O_{11}+nHO,$$
$$2NaO,BiO_3.C_{12}H_5O_{11}+nHO,$$
$$2LiO,\ BiO_3.C_{12}H_5O_{11}+nHO.$$

Not having obtained yet any of these salts in scales, I cannot state the equivalent of HO.

I have remarked, also, that the 2 equivalents of alkali necessary to form the neutral citrate need not be of the same base; thus 1 equivalent of soda and 1 of lithia form a neutral soluble citrate with 1 equivalent of citrate of bismuth, &c.

All these double citrates are soluble and uncrystallisable.

My study of the citrates is very far from being completed; but I have collected facts enough to justify me in proposing to divide the different citrates into three classes.

In the *first class* I would place all the various simple citrates, where the acid is combined with 1, 2, or 3 equivalents of one base. These are so well known that little need be said about them.

The *second class* would comprehend the double citrates, that is, those salts in which 1 equivalent of citric acid is

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combined with 2 equivalents of an alkali and 1 equivalent of another base, generally metallic. The simple citrate of this base is in most cases insoluble or little soluble in water, while the double citrate is soluble in all proportions. The various double citrates of bismuth mentioned in this paper may be considered as types of this class. This class of salts is very large; a great many are known and mentioned, such as ammonio-citrate of bismuth, ammonio-citrate of iron, potassic-citrate of magnesia, zinc, &c. The composition of none of them, however, is stated anywhere to my knowledge.

The *third class*, or quadruple citrates as I propose to call them, is not so well known, the only one being, I believe, the soluble pyrophosphate of iron discovered in 1856 by E. Robiquet, my late friend and employer. I consider these salts as a combination in which an alkaline neutral citrate plays the part of a base, and a peculiar metallic salt the part of an acid. I have already collected several facts in support of this theory, but they require proper elucidation and study to prove it conclusively. I will only mention that, in following up this theory, I have already discovered the following new combinations, which I place in the third class:—

Phosphate of sesquioxide of iron,		
Hypophosphate	,,	,,
Valerianate	,,	,,
Arseniate	,,	,,

in combination with the neutral citrates of potassa, soda, lithia, and ammonia.

All these salts are uncrystallisable, soluble in water in all proportions, little so in alcohol; they have no taste of iron; all are decomposed by direct sunlight, and all have a greenish colour, varying from bright apple-green to dark olive-green. The valerianate of iron, possessing by itself a bright red colour, forms, with citrate of ammonia, a combination of an extremely bright green colour.

I have obtained all these salts in solution, and some of them in scales. The solutions keep very well for a long time if about 16 per cent of alcohol be added and direct sunlight excluded: they may be preserved, also, by the addition of enough sugar to give them the strength of officinal syrup (a little less than twice their weight).

I have not analysed any of them yet, but will publish the results of their analysis as soon as satisfactorily obtained.—*American Chemist.*

ON THE

EVIL EFFECTS OF THE USE OF ARSENIC IN CERTAIN GREEN COLOURS.*

By FRANK W. DRAPER, M.D.

(Continued from p. 41).

V. *Paper-Hangings.*—Important as are the topics which have thus far engaged our attention in the study of the arsenical greens and of the possible dangers incident to their use, they appear to have always been considered as of less significance than those relating to arsenical paper-hangings. Since Professor Gmelin, of Heidelberg, called attention, in 1843, to what he deemed the deleterious effects of living in rooms whose walls were decorated with green paper, the subject has been repeatedly investigated in all its relations. Distinguished scientific authorities in Germany, France, England, and America have regarded the matter as one eminently deserving careful consideration, and the unanimity which characterises the results of their studies can leave little room for doubt in unprejudiced minds concerning the harm which may ensue, under certain conditions, from the use of arseniferous wall-paper. Other observers, comparatively few in number, who have arrived at negative or at wholly dissenting conclusions, seem to have based their experiments on wrong premises, or to have shown partiality in their statements.

As a result of the unequivocal warnings published by physicians in past years, the use of the arsenical paper-hangings became for a time and in some degree unfashionable. But the dictates of fashion are capricious, and are not long mindful of the protests of science. The public has forgotten the experiences of ten years ago, and the poisonous paper-hangings are displayed in the shops to-day with the same fascinations of colour, design, and finish that has characterised them in the past. In every store which the writer has visited in the course of these investigations, specimens of the paper have been obtained which, on being tested, exhibited the presence of the arsenical pigment in a greater or less degree.

This renewal of a practice which has been condemned heretofore in terms of unconditional disfavour justifies a renewed investigation of the subject. It is a matter of no ordinary importance to a community to know that, by the use of paper-hangings of a certain colour, the health of individuals is seriously jeopardised. It is not a pleasant thing to realise that the very means we take to make our homes more cheerful may become the direct source of impaired health, and that the beautifully artistic designs which decorate the rooms in which we live or sleep may be the subtle agencies whereby the sum of human misery is increased.

It ought to be remembered, at the outset of this inquiry, that all paper-hangings which are green are not to be condemned as poisonous. Not a small proportion owe their tint to other pigments than the arsenite of copper. And this fact that the arsenical papers are found in comparatively good company adds another element of importance to the subject, suggesting the greater need of discrimination. Moreover, with regard to paper-hangings which are actually arsenical, it will be perhaps exceptional to find specimens coloured to any great extent with the unadulterated arsenite or aceto-arsenite of copper, as distinguished by the purity and brilliancy of the green tint, because it is the custom of the manufacturers to modify the shade of green by the addition of substances which shall make the tint darker or lighter to suit varying tastes; yet the primary pigment contains arsenic, whose presence can be detected only by the chemist's test, and not by any distinctive physical appearance. To proscribe a wall-paper, therefore, because it is green, and without further test to condemn it, even though it be found on the room of a confirmed invalid, would be hasty judgment, while, on the other hand, cases undoubtedly occur in which obscure and distressing symptoms are due to arsenical poisoning, the agent being concealed in a tint bearing so distant a resemblance to the brilliancy of pure emerald green as to readily escape detection.

In the manufacture of paper-hangings, no provision is made with a special view of anticipating and preventing any possible harm which may result from the employment of the arsenical pigment. Whether the pattern be a plain or a figured one, the colouring matter is made to adhere to the paper by means of size. The emerald green, generally adulterated with Paris white or some other neutral agent in order to obtain the desired shade, is mixed with warm water in which size has been dissolved; in this process of colour-mixing the workman often uses his hands, plunging the fore-arm nearly up to the elbow into the sieve through which the ingredients are passed. When the colour is prepared, it is applied to the surface of the paper by means of a series of brushes worked by machinery, and a uniform coating is thus quickly secured. Passing from this machine, the paper is suspended in long loops from sticks which rest on a slowly moving, endless chain arranged near the ceiling; being carried thus in loops the length of a long room whose temperature is maintained at a high degree by steam apparatus, the paper becomes thoroughly dried. If it is to be "satined," or glazed, it is passed through a series of dry brushes which revolve with great rapidity. The figured patterns are printed by

* From the "Third Annual Report of the State Board of Health of Massachusetts."

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two methods. The slower, but more accurate process, and therefore better adapted for fine work, is by hand-printing, the pattern being secured by blocks, a colour at a time, precisely as in the earliest days of paper-hangings. But most of the printing is done by machinery not unlike that used in calico printing. The paper is passed against a series of revolving wooden cylinders, on whose surface are raised figures corresponding respectively with the individual shades of colour to be observed on the paper when finished; each cylinder is fed with its own pigment by means of a revolving belt of fine woollen, which passes through a trough of colour. The variety called "flock-paper" requires a special process to give it the well-known roughened or velvety aspect. The flock consists of the finely-divided shreds of waste woollen cloth. The stock is scoured and dyed. It is then stove-dried and ground to a fine powder; the requisite degree of fineness is secured by successive sifting in a bolting apparatus. A quantity of this woollen dust is enclosed in a large chest or drum, the bottom of which consists of sheep-skin or of strong cloth. The paper is first prepared with a layer of size and then of varnish. If the paper is to be a plain flock, this adhesive material is spread uniformly; if figures are desired, the pattern only is printed in varnish. Successive portions of the paper are passed into the drum, and, the bottom of the chest being beaten, the flock dust is raised to settle on the still moistened and adhesive surface, where it is allowed to dry.

From this description it will be seen that the arsenical paper-hangings include three well-defined varieties, according to the methods used to attach the colouring matter to the surface of the paper with greater or less degree of permanency; they are unglazed, or satined, or flock. These comprise all grades, from the most costly to the cheapest, and vary from the plainest surface to the most elaborately figured designs. In some there is a thick coating of the colour, loosely applied, either for a perfectly undecorated paper or to serve as a ground on which to impress the various figures. In others, only isolated or small patterns of foliage contain the green pigment. Of all the varieties, however, those which have an unglazed surface are the most likely to produce harm, since in this class the colour is only moderately adherent, and is removed by the slightest friction. The glazed papers are less open to this objection, because the process which gives the polish serves also to fix the pigment more securely. From such a surface the green dust would not escape readily, until, after long wear or by frequent dusting abrasions in the glazing were produced. The flock papers occupy an intermediate place between the two varieties alluded to. The wool which constitutes the flock is generally of a dark green colour from vegetable dyes; and if the arsenical pigment is used, it is found in the ground tint on which the flock is laid, or in the green-figured foliage formed in the intervals. The flock, as primarily prepared, is not poisonous; but it may become so, since it is easily detached from the paper, and may bear away with it particles of the subjacent colour.

The quantity of the poisonous colour which is used upon these papers varies exceedingly, of course, but occasionally it is found in very large amount. Professor Bacon asserts: "Frequently so much as 50 or 60 grains of the arsenical pigment is spread on each square foot of the paper."* In a specimen examined by Dr. Halley, nearly a drachm of the colour was found in the square foot;† and Dr. Taylor states the results of his analyses to vary from 28 to 70 grains in the same surface.‡ Two samples of the paper are exhibited; they have been analysed for the writer by Mr. Pearson at the Institute of Technology. The lighter-coloured specimen contains 5·42 grains of arsenic in each square foot. The paper also shows under what a deceptive guise the arsenical pigment may appear. The second sample, which is typically arsenical, and which represents the colour in its purity, has 29·32 grains of pure arsenic in each square foot. Taking the average of these results, a room of ordinary dimensions, decorated with arsenical paper-hangings, would hold on its walls considerably more than a pound of a poisonous colouring matter containing half its weight of arsenic.

The question, however, which most concerns us is, Does the presence of this pigment, in such large amount, on the walls of rooms habitually occupied by day or night exert any deleterious influence on the health of the occupants? Can an agent, avowedly very poisonous when swallowed, become disengaged in any way, directly or indirectly, from the surface to which it is but loosely attached, and contaminate the atmosphere to such a degree as to produce, by slow but continuous absorption, unmistakeable symptoms of injury? There will be those who, through incredulity or from motives of interest, will cite cases of perfect immunity under such conditions, and will maintain that the brilliant colour is inert, even granting the presence of arsenic, and that there is nothing in the paper-hangings in question to arouse alarm or suspicion. The alleged cases of illness from this cause ought rather, they say, to be attributed to bad ventilation and other abuses. Nevertheless, when the many recorded and well authenticated instances of impaired health, including a considerable number which have terminated fatally, are examined impartially, little room is left for scepticism. The cases are too numerous and too unequivocal to be thrown aside, and constitute a mass of evidence which cannot well be refuted. It will be unnecessary to cite a great number of these cases here. The columns of the medical and of the general press of the last ten years contain the histories of numerous instances; and of these only a few of the typical ones will be quoted as illustrations.

Dr. Halley, of London, has reported a case of arsenical poisoning in which he was himself the victim. His library walls had been covered with a newly-made, rich, emerald-green flock-paper. Shortly after the work was finished, he commenced to occupy the room every evening for some five or six hours, a single gas-burner supplying the light. After a few days he began to suffer considerably in health; there was constant headache, dryness of the throat and tongue, with internal irritation. After three weeks of this experience, he became completely prostrate, not yet, however, suspecting the cause of his malady. Partial paralysis of the left side supervened. His condition obliged him to discontinue his studies in his library, and coincident with this intermission he began at once to recover. But as soon as he re-commenced his labours the symptoms recurred. His attention was now called to the paper on the walls of the apartment. It was found to contain nearly 60 grains of Scheele's green to the square foot. The air of the room was likewise tested, and distinct crystals of arsenic were obtained from the dust. The paper was at once removed, and there was no further trouble.*

In 1862, a case of fatal poisoning under the conditions in question occurred in the suburbs of London, the victim being a child. The cause of death was made the subject of an investigation before a coroner's jury. In the course of the evidence, it transpired that the deceased was the last of four children who had died within a period of two months under exposure to the poison contained in the paper-hangings of the room they habitually occupied. They had all been attacked in the same manner, the prominent symptoms being referred to the throat. The colour was loosely applied, having no glazing. It was very deliquescent; at 50° it was quite damp, and the stain came off on the hand like paint. Three grains of arsenic were found in a square foot of the paper. The symptoms were attributed by the surgeon in attendance, Mr. Orton, and by Dr. Letheby, who made the *post mortem* chemical examination, to arsenical poisoning.†

* *Boston Med. and Surg. Journ.*, vol. lxix., p. 490.
† *Medical Times and Gazette*, Jan. 16, 1868.
‡ Taylor, "On Poisons," p. 434.

* *Med. Times and Gazette*, Jan. 16, 1858.
† *Med. Times and Gazette*, May 3, 1862.

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In a case reported by Dr. Guy, the patient being a young lady, there were observed gastric irritation, emaciation, flatulence, pain in the abdomen, loss of appetite, nausea, a furred tongue, dryness of the mouth and throat, a quick, small pulse, oppressed respiration with dry cough, failure of strength, an aversion to food and drink, a blanched complexion. Temporary absence from home brought relief to the sufferer, but it was not until after recurrences of the symptoms coincident with the return to the arsenical room that the wall-paper was suspected. The paper was removed, and a plain white paper took its place, and no further symptoms of poisoning were experienced. The workman who removed the arsenical paper was very ill the whole night and day following, "with cramps, sickness, and pain." The green paper was a glazed, watered pattern, covered with two shades of the most delicate tint.*

Dr. Hinds reports an experience not unlike that of Dr. Halley. He says:—

"In 1849 I ordered my study to be re-papered, and I selected for this purpose a neat paper, with only about two shades of green, of a bright and elegant tint. In a day or two after the room was papered I began to use it. I had a fair gas-light, and towards evening I began to read. When about an hour and a half to two hours had passed, symptoms of severe depression seized me, soon followed by a feeling of nausea and an inclination to vomit. There were occasional pains in the abdomen also, and the prostration was presently accompanied with a feeling of faintness which suspended my operations. The very same thing occurred every successive evening, when the door of the room was closed, the gas-light burning, and after I had remained about a couple of hours in the room. The unpleasant symptoms gradually subsided when I had left the room, a feeling of faintness and some stomachic derangement alone remaining."

The green pigment, on being sublimed in a test-tube, gave abundant crystals of arsenious acid. The paper was removed, and the annoyance never reappeared.†

Dr. Hinds also reports other cases under his personal observation. In one of these, a gentleman of Birmingham had two parlours papered with a bright green paper. In less than a week afterwards, both himself and his wife, previously in good health, became ill. They were in the habit of sitting in one of the rooms regularly. The symptoms complained of were great prostration of strength, headache, and a low, febrile condition, together with inflammation of the eyes (*conjunctivitis*), thirst, loss of appetite, heat and dryness of the throat, with tightness across the forehead. The great inaptitude for exertion and general prostration of the strength appeared prominent. As in the previous cases, temporary absence from home was attended with a remission of the symptoms, and the removal of the paper was followed by early and complete restoration of health. The paper was of the "flock" variety, with a profuse pattern of a light and elegant green on a flock ground, yielding, on analysis, an abundance of arsenic.‡

Dr. James Whitehead, of Manchester, has recorded an instance, which may be cited as a typical one, not only as illustrating the disease in question, but as affording an example of the difficulties sometimes experienced in determining its true character. The patient, a young man, suffered from ulceration of the gums and tonsils, violent frontal headache, great languor, nausea and occasional vomiting, inappetence for exertion, and disturbed sleep. The complaint, mild at its onset, gradually increased in severity in spite of medical treatment, and at the end of eight or ten weeks the patient was removed to the country; here he was speedily restored to health. On his return home, perfectly well, he was placed in the same room he occupied before; in the space of four weeks he was worse than ever. The drains being suspected of some indirect influence in causing the diseased condition, they were examined, but nothing was discovered to account for the trouble. Attention was next directed to a cistern which adjoined the wall outside the patient's room, and it was re-modelled with the hope of remedying the mischief. The repairs necessary for this change required the patient to occupy another room for a fortnight; this intermission was attended with considerable relief, and he returned to his old apartment feeling much better. The former symptoms recurred with aggravated severity, and now for the first time it was suspected that the wall-paper was the source of the mischief. The paper was replaced without loss of time by one of a totally different shade, and results in every way satisfactory followed. There was no relapse of the symptoms after the removal of the paper, and the young man occupied the room without further annoyance.

The paper was a "rich green flock paper." While it was being applied, a green dust escaped freely; and afterwards, whenever the walls were cleaned, a similar powder was found on the furniture. 30 grains of the pigment yielded, on chemical analysis, 11 grains of arsenic, and it was estimated from this that the room, having a superfices of 350 square feet, held in its paper-hangings, after four years of usage, 3,850 grains, or about half a pound, of white arsenic.*

(To be continued.)

* "Fifth Report Medical Officer Privy Council," p. 137.
† *Med. Times and Gazette*, May, 1857.
‡ *Med. Times and Gazette*, May, 1857.

ON DYES AND DYE-STUFFS OTHER THAN ANILINE.†

By Dr. F. CRACE CALVERT, F.R.S.

(Continued from p. 41).

Carmine Lakes.—These very beautiful pigments are prepared from a decoction of cochineal, and not from carminic acid, the animal matter which the insect contains, appearing to be necessary to their production. The mode of preparing the finest qualities is kept a secret by the manufacturers; but I will describe two processes which give very satisfactory results. The first consists in boiling one pound of ground cochineal with two gallons of water, to which has been added one ounce of alum. It is then boiled for three minutes, the liquor is allowed to settle, and, after having been kept for several days, about an ounce of a bright carmine lake is produced. For the alum employed in this process cream of tartar can be substituted. The second process consists in boiling for three hours two pounds of powdered cochineal in thirty gallons of water. To this is added three ounces of pure saltpetre. The liquor is then boiled again and left to settle. The clear liquor is run off, and after two or three weeks yields a fine carmine lake.

As these lakes are expensive, they are often adulterated with starch, kaolin, vermillion, &c. The complete solubility of pure carmine lakes in ammonia affords a ready means of detecting these adulterations.

Kermes.—This colouring-matter is also derived from a variety of *Coccinus*, which lives on the species of oak called *Quercus coccifera*. The young female animal fixes itself under the epidermis of the leaves or young shoots of the oak, in the early part of spring. As the insect grows, it gradually swells out the epidermis, covering the surface of the leaves or branches with a multitude of excrescences. During this period it deposits its eggs.

In Spain and the South of France, during the month of June, or just before the eggs produced would be hatched, the animals are removed, and destroyed by placing them in the steam from heated vinegar.

Although this colouring-matter is seldom used in England, it is extensively employed in the South of France, in Spain, Morocco, and Turkey, to dye morocco

* *British and For. Med. Chir. Rev.*, vol. xxiii., p. 519.
† The Cantor Lectures, delivered before the Society of Arts. Revised and communicated by the Author.

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leather, and to dye woollen cloth with that particular shade which characterises the cap called "fez," worn by the Asiatics.

If the colour is not so brilliant as that of cochineal, it has the advantage of not being changed by soap or dilute alkalies. It is also employed at Milan, Rome, and Florence to colour a very favourite beverage known as alkermes. The colour-giving principle of this insect is identical with that of cochineal, and has been used as a dye in the East from time immemorial.

Gum-lac.—This is another variety of the *Coccinus*, which lives especially on the *Ficus*, or fig tree. They reproduce themselves with such rapidity and in such numbers that they entirely cover the surface of the branches of the trees on which they are deposited. Owing to a resinous fluid which they secrete, they form solid masses, which are often a quarter of an inch thick, all round the branches, and adhere very firmly to them. The natives break of these branches just before the hatching season of the animal, and expose them to the sun to kill the insect. These gum-lac twigs are sold under the name of stick-lac. Those of Siam are considered the best, those of Assam next, and those from Bengal the worst.

There are three kinds of lac in commerce—stick-lac, which has just been described, seed-lac, and shell-lac. The resinous concretion is taken from the twigs, coarsely powdered, and triturated with water in a mortar. The greater part of the colouring principle is thus dissolved.

The granular portion which remains is dried in the sun, and constitutes seed-lac. Shell-lac is obtained by melting seed-lac, and straining whilst hot. It is then dropped upon smooth stems of the banyan tree, and so runs into thin plates, which are known in commerce under the name of shell-lac.

These three lacs have the following composition :—

	Stic-lac.	Seed-lac.	Shell-lac.
Resin	68·0	88·5	90·9
Colouring matter ..	10·0	2·5	0·5
Wax	6·0	4·5	4·0
Gluten	5·5	2·0	2·8
Foreign matters ..	6·5	—	—
Loss	4·0	2·5	1·8
	100·0	100·0	100·0

The colouring matter of the insect is identical with that of cochineal and kermes, and it has been employed as a scarlet dye-stuff in the East from time immemorable.

Lac-lake and Lac-dye are preparations imported into this country from India since 1796. They are both prepared by acting on stick-lac by a weak alkaline solution, to which is then added a solution of alum. This produces a precipitate, which, when washed and dried, is ready for use. Although both these lakes are prepared with the same substances, lac-dye is considered much superior in quality. This is due to the greater care bestowed on its preparation. The details of the process are kept secret.

To dye woollen cloths with them, they are dissolved in a weak solution of vitriol, to which is added a little oxymuriate of tin, and the cloth dipped in when the liquid is near the boil. It only requires washing and finishing to be ready for market.

Some years ago Messrs. E. Brooke and Co., of Manchester, introduced a lac-dye much superior to that imported from India, which they prepare by treating stick-lac with weak ammonia, and adding chloride of tin to this solution, when a fine red precipitate is formed, which, collected, is ready for use.

Murexide or Roman Purple.—Although this colour has now been superseded by those derived from coal-tar, I call your attention to it as an example of the assistance rendered by the progress of chemistry to the art of calico-printing.

In 1776, the illustrious Swedish chemist, Scheele, discovered *uric acid* in human urine. In 1817, Brugnatelli found that nitric acid transformed uric acid into a substance which he called *erythric acid*, but which was afterwards named by Wöhler and Liebig *alloxan*. In 1818, Dr. Prout found that this latter substance gave, when in contact with ammonia, a beautiful purple-red colour, which he named *purpurate of ammonia*—the product known by the name of *murexide* since the researches of Liebig and Wöhler in 1857. These discoveries remained dormant in the field of pure science until the year 1851, when Dr. Saac observed that when alloxan came in contact with the hand it tinged it red. From this he inferred that it might be employed to dye woollen fabrics red, and further experiments showed that if woollen cloth, prepared with a salt of tin, were passed through a solution of alloxan, and then submitted to a gentle heat, a most beautiful and delicate pink colour was obtained.

In 1856, MM. Depouilly, Lauth, Meister, Petersen, and A. Schlumberger applied it as a dying material to silk and wool, and succeeded in producing red and purple colours, by mixing the murexide with corrosive sublimate, acetate of soda, and acetic acid.

For printing upon cotton, a mixture of murexide with nitrate of lead or acetate of zinc, properly thickened, was printed on the fabric, which was then allowed to dry for a day or two, when the colour was fixed by passing them through a mixture of corrosive sublimate, acetate of soda, and acetic acid.

The uric acid required for the preparation of such large quantities of murexide was obtained from Peruvian guano. The guano was treated with hydrochloric acid, and washed. The insoluble mass was then treated with nitric acid of specific gravity 1·40. When the action of the acid was completed the mass was treated with warm water to dissolve out the alloxan. It was then carefully evaporated to such a degree that it became solid on cooling. The solid mass had a brown or violet colour.

(To be continued.)

NOTICES OF BOOKS.

Air and Rain: The Beginnings of a Chemical Climatology. By ROBERT ANGUS SMITH, Ph.D., F.R.S., F.C.S., (General) Inspector of Alkali Works for the Government. London: Longmans and Co. 1872.

DALTON, the father of meteorology as well as of strictly scientific chemistry, declared in the later years of his life that chemical experiment could not distinguish the air of Manchester from the air on Helvellyn. Presently we shall see what progress has been made in chemical determination. Dr. Smith very modestly terms his work the "Beginnings" of a chemical climatology; but although most of what has been done in this department of sanitary enquiry has been commenced and carried out by Dr. Smith, his title is unfair to himself, because he has carried his investigation to the limits of present chemical science.

"Chemistry," says Dr. Smith, "has not hitherto done enough in sanitary enquiries, and it ought to be able to relieve medical men of much of their heavy responsibility, although no subject relating to health can be entirely taken out of their hands." Again, "We rush over the world, scarcely considering that the air we inhale must change at almost every step; and we build our houses, not thinking that every field has a climate of its own, unless circumstances are more nearly the same than we can hope for in our country. In extensive tracts, where soil, level, and inclination are similar, such as great prairies or steppes, there will be few changes until the borders are approached, in which case contiguity of other surfaces will produce a variation. In England, which is a comparatively small country, with much variety of soil, it is difficult to find a place where a short distance does not produce some change; and in Scotland, a still smaller and more varied country, the differences of climate are

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even more striking. Indeed, every farmer studies his land in this respect; and the fields are devoted to various purposes, according to climate as well as soil." These quotations serve to show not only the importance of the investigation, but as well the acknowledgment of its importance by the investigator, of whose indomitable energy in the pursuance of his scientific convictions chemists are well aware. The Inspector under the Alkali Act is pre-eminently the one who should commence the systematic study of the subject before us, both because of his scientific attainments and the minute accuracy with which his experiments are made and recorded, telling us exactly how the matter stood when the experiments were commenced, the work done, and the result at completion.

Regnault was the first to begin to refine the study of the air, and to show the distinction in the amount of oxygen in pure and tainted air; a portion of Dr. Smith's work has been to complete and further detail the determinations. The results show the *amount* of difference between the atmospheres of the mountains, of great plains, and of cities. "It is true," says Dr. Smith, "that in figures this appears small; but what is the meaning of small; if we measure size by percentage it will appear small; but still smaller will appear the strychnine that destroys us, if we estimate the amount as a percentage of the weight of our bodies."

We proceed to extract from the voluminous tables some of the most general numerical results:—

Oxygen in the Air.
(Per cent, or, if read as whole numbers, per million).

	Vol. per cent.
N.E. sea-shore and open heath (Scotland)	20·9990
Tops of hills (Scotland)	20·9800
In a suburb of Manchester in wet weather	20·9800
,, ,, ,,	20·9600
Swampy places, favourable weather, France and Switzerland .. ..20·9220 to	20·9500
In fog and frost in Manchester	20·9100
London, open places, summer	20·9500
In a sitting-room, which felt close, but not excessively so	20·8900
In a small room with petroleum lamp ..	20·8400
Ditto, after six hours	20·8300
Pit of theatre, 11·30 p.m.	20·8300
In sumps or pits in a mine (average of many)	20 1400
When candles go out	18·5000
The worst specimen yet examined in a mine	18·2700
Very difficult to remain in for many minutes	17·2000

"Some people," continues Dr. Smith, "will probably enquire why we should give so much attention to such minute quantities—between 20·980 and 20·999—thinking these small differences can in no way affect us. A little more or less oxygen might not affect us; but supposing its place occupied by hurtful matter, we must not look on the amount as too small. Subtracting 0·980 from 0·999, we have a difference of 190 in a million. In a gallon of water there are 70,000 grs.: let us put in an impurity at the rate of 190 in 1,000,000; it amounts to 13·3 grs. in a gallon, or 0·19 grms. in a litre. This amount would be considered enormous if it consisted of putrefying matter, or any organic matter usually found in waters. But we drink only a comparatively small quantity of water, and the whole 13 grs. would not be swallowed in a day, whereas we take into our lungs from 1000 to 2000 gallons of air daily. The detection of impurities in the air is, therefore, of the utmost importance, and it is only by the finest methods that they can be ascertained in small quantities of air, even when present in such quantity as to prove deleterious to health."

The fraction of a per cent usually considered to be an extremely small quantity, and, if belonging to the second decimal place, unworthy of regard, Dr. Smith shows to be of the highest importance, from the fact that the amount of sulphuric acid in the air is still less than of *the carbonic* acid, and yet a greater effect is produced on the atmosphere than is indicated by the amount shown in the oxygen or carbonic acid volumes. Thus Dr. Smith concludes that we must pay attention to the number in the second place for oxygen, and that in the case of carbonic acid we must attend to the third even now, and for scientific purposes even to the fourth, or one part in a million. 0·0314 and 0·0400 per cent may mean 314 and 400 in a million: the difference is 86 in a million, a quantity perceptible to the senses; while we must know that the effect of poisons on health is not in proportion to the effect on the sensations. Continues Dr. Smith, "Let us consider what is meant by this 86 in a million. A room twice the size of one not unusual, or two 30 feet long, 24 wide, and 15 high, will contain 21,600 cubic feet, or 37,324,800 cubic inches. If we introduce 0·0086 per cent. we bring 3209 cubic inches of carbonic acid into the room, which will be considered a large amount if put together in vessels: it is nearly 12 gallons. During fogs there will be an addition of nearly five times the amount = 60 gallons, or 405 in a million. If we take the numbers found in a very moderately close building, we add 1235 in a million, or fourteen times the first amount, or 168 gallons. If we make the room as close as a crowded theatre, taking the number given for one in London 0·320, we add 2831 in a million, or 377 gallons. And when we come to the state of air in mines we have various numbers, in a few instances rising to more than 2 per cent—nearly a million cubic inches, which would be 578 cubic feet for the supposed room, which does not differ far from this in which I now speak (the Meeting-room of the Literary and Philosophical Society of Manchester)."

The air collected at various stations is contained in a bottle of about 2000 c.c. capacity, or nearly two quarts. About a tenth of a cubic foot of the air is washed with the purest water (previously tested), this water being then submitted to the process for testing waters as given by Messrs. Wanklyn, Chapman, and Smith. The amount of air taken is, of course, accurately measured; and with reference to the organic matter, or even of inorganic salts, many bottles full are necessary. But there is so much new and important material for thought in all the experiments Dr. Smith has made, that to give an extract of his method of working would lead us beyond the limits of a book notice.

Still there is one more quotation to be rendered before we can close this admirable book. In speculating on the dispersion of organic germs, Dr. Smith says:—"We have many people so afraid of this organic matter of the air, and of all its floating particles, that they would like to filter it all out, and breathe the gases pure. We must not allow our fear to go too far. We have no reason to be sure that air free from floating particles would be wholesome; we have only the proof that, if there is an excess of some kind, it is unwholesome. Apparently everyone can breathe air tainted with any disease without being hurt, if the taint is small enough. Inconceivably small particles injure; but we must learn to divide even the inconceivably small. We can bear a larger amount of taint if it is diluted enough. Dilute sufficiently the air of a hospital, and infection ceases. One short time of the infected air produces disease; a long period of the diluted air produces none, although the number of particles that must pass over a certain spot must be much greater in the long time than when the stronger mixture passes in the short time. We learn from this that the amount that does injury is not infinitesimal; there must be a certain quantity. I do not doubt that we shall measure that readily: we can readily measure the amount of ammonia and organic matter in the infectious and non-infectious atmospheres. . . . . I do not feel hopeless of being able to say that in a scarlet-fever atmosphere there must only be so much nitrogenous organic matter and so many germs, otherwise infection will be certain."

Of the data of the second portion of the work, that

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on Rain, we have already spoken in our notice of the Report under the Alkali Act, in which the subject-matter was given.

Not only the chemist will be interested in this work of Dr. Smith's; it appeals to the consideration of everyone, that is, of everyone who cares for health and comfort.

Proceedings of the American Pharmaceutical Association at the 19th Annual Meeting held in St. Louis, Mo., September, 1871. Philadelphia: Sherman and Co., Printers.

THIS large volume contains in the first place the Minutes of the Nineteenth Annual Meeting; even these alone contain a large and highly valuable amount of information on various subjects relating to pharmacy, pharmacognosy, and kindred subjects. Next we meet with the reports of various committees, from which it appears that chemistry is more and more appreciated by the American pharmacists, a fact still better illustrated by the contents of the special and volunteer reports and essays. As we intend reproducing some of the more prominent papers and essays, it is hardly necessary to enter here into more particulars respecting a volume the contents of which speak highly in favour of the advanced state of efficiency, practical as well as theoretical, attained by the large number of American pharmacists. We should wish to see this volume and its predecessors in the library of every pharmacist in this country as a kind of annual cyclopædia on everything connected with pharmacy. The work is enriched with a complete general index to Vols. ix. to xvii. inclusive.

CORRESPONDENCE.

POWERFUL GALVANIC BATTERY.

To the Editor of the Chemical News.

SIR,—It may interest your readers to know that the following cheap and simple battery is nearly 50 per cent higher in potential than a Grove or Bunsen, and fully 150 per cent higher than a Daniell.

For negative, carbon packed in granulated carbon, peroxide of manganese, and precipitated sulphur; the liquid should be dilute acid—sulphuric is best. For positive, zinc in caustic potash or soda.

The potential is higher than any I know, excepting, of course, those which have magnesium, sodium, or potassium for positives.

The internal resistance is rather large; if common salt or chloride of potassium be used instead of caustic alkali, the internal resistance is much less, but the potential sinks to a little more than 10 per cent higher than a Grove. With dilute sulphuric acid on both sides, the resistance is still less, but the potential is only a little higher than a Grove.—I am, &c.,

H. HIGHTON.

2, The Cedars, Putney.

MISCELLANEOUS.

Proposed Association of Manufacturing Chemists.—It having been proposed that the Tyne Social Chemical Society should undertake the organisation of the larger association, a meeting of the members was convened to consider the proposal. The following resolution was carried:—"The Tyne Social Chemical Society is a society of managers and chemists only, and not of manufacturers; and the Council think that the organisation of the proposed association should proceed in the first instance from the manufacturers themselves." We trust that the manufacturers, most of whom admit the desirability of the association, will at once adopt means for its formation.

University of London.—The following are lists of the candidates who have passed the recent B.Sc. and Preliminary Scientific Examinations:—*First B.Sc. Examination*—First Division. James Barnes, Owen's College; Cornelius Bulbeck, Private Study; Edward Albert Butler, B.A., private study; Frederic Chapple, B.A., Wesleyan Tr. and University Colleges; Claude Clarke Claremont, University College; Henry Wade Deacon, King's College; Frederick William Frankland, University College and Royal School of Mines; Arthur Walton Fuller, Owen's College; James Edward Harris, B.A., private study; Richard Henry Jude, Christ's College, Cambridge; John Frederic Main, private study; Arthur Milnes Marshall, B.A., St. John's College, Cambridge; Arthur Samson Napier, Owen's College; John Edward Neale, University College; Henry Shoveller Roberton, B.A., Old Trafford School and Owen's; John Charles Saunders, Downing College, Cambridge; Jas. Heber Taylor, M.A. Camb. and Oxon., Trinity College, Cambridge; James Cecil Witton, private study; William Barton Worthington, Owen's College. Second Division. Richard John Anderson, Belfast College; Frederic Harvey Barling, Owen's College; Judson Sykes Bury, Owen's College; Adam Speers, private study; Edward Worsdell, B.A., Flounders College. *Preliminary Scientific (M.B.) Examination.*—First Division. John Henry Barnard, private study; William Henry Blake, University College; James Blamey, University College; Harry Beecham Briggs, King's College; Robert Edmund Carrington, Guy's Hospital; Claude Clarke Claremont, University College; Charles Walter Evans, University College; Richard Hingston Fox, London Hospital; George Aldridge George, University College; Francis Goodchild, Epsom and University Colleges; John Benjamin Hellier, Leeds School of Medicine; George Courtenay Henderson, University College; Wilfred Francis Hopwood, Manchester Grammar School; Edwin Joseph Le Quesne, St. Bartholomew's Hospital; Howard Griffiths Lowe, Queen's College, Birmingham; Arthur Milnes Marshall, B.A., St. John's College, Cambridge; Charles Arthur Mercier, London Hospital; John Edward Neale, University College; Howard Douglas Stewart, King's College; Nestor Isidore Charles Tirard, King's College; Benjamin Arthur Whitelegge, University College; James Cecil Witton, private study; William Barton Worthington, Owen's College. Second Division. Richard Jonn Anderson, Belfast College; Albert de Winter Baker, Guy's Hospital; Richard Legg Batterbury, King's College; Henry Blake, St. George's Hospital; Judson Sykes Bury, Owen's College; Herbert Duke, Guy's Hospital; John Christian Ferrier, Guy's Hospital; Alfred Finch, Guy's Hospital; George Michael James Giles, St. Mary's Hospital; Alexander Gray, Guy's Hospital; John Gatchell Hancock, King's College; Joseph William Hunt, University College; Alfred James, University College; Richard Henry Jude, Christ's College, Cambridge: Walter Aubrey Kidd, Guy's Hospital; William Henry Maberly, Edinburgh University; Frederick Daniell Miller, King's College; Thomas Mark Pinnell, University College; Joshua Powell, University College; James Woolley Roughton, King's College; William Joseph Seward, University College; William Allason Simmonds, Guy's Hospital; Edward Arthur Snell, King's College; Arthur Bayly Vanes, Queen's College, Birmingham; Sidney Patteshall Wilding, University College.

Trial of the Pyx.—This annual trial of the weight and purity, according to Standard, of the gold and silver moneys coined at the Royal Mint during the past year, was held on July 19th at the Goldsmith's Hall, in pursuance of the provisions of the Coinage Act, 1870, 33rd Victoria, cap. 10. This trial of the Pyx is one of the most ancient customs we retain. The following extract from the first schedule of the Coinage Act, 1870, will show at a glance the delicacy of test to be observed by the jury in weighing, and assaying the various moneys submitted to their trial, and the closeness to Standard

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to which the officers of the Mint are compelled to work. The Imperial weight in grains only is here given :—

Coin.	Weight.	Remedy.
Sovereign	123·27447 ..	0·20000
Half-sovereign ..	61·63723 ..	0·10000
Florin..	174·54545 ..	0·72727
Shilling	87·27272 ..	0·36363
Sixpence	48·63636 ..	0·18181

The Standard fineness for gold coins is 11-12ths fine gold, and 1-12th alloy, or millesimal fineness 916·66; the remedy or margin allowed to the Master of the Mint on coinage, being millesimal fineness 0·002. For silver coin the Standard fineness is 37-40ths fine silver and 3-40ths alloy, or millesimal fineness 925·0, the remedy being millesimal fineness 0·004. Before the jurors proceeded to the laboratory to commence their operations, they were furnished with small portions of the standard trial plates, in the custody of the Board of Trade, to guide them in their assay of the coins deposited in the Pyx. The amount of gold moneys coined at the Mint from the 1st of July, 1871, to the 30th of June, 1872, was £13,298,658, out of which coins to the value of £18,718 were deposited in the Pyx, or box, consisting of 18,464 sovereigns and 508 half-sovereigns: and the amount of silver moneys so coined within the same period was £996,138, out of which coins to the value of £357 18s. 6d. were likewise deposited in the Pyx, consisting of 2508 florins, 1798 shillings, and 646 sixpences; and of Maundy moneys, two fourpences, 80 threepences, 2 twopences, and 6 one-penny pieces. The average amount of gold coined during each year is five millions, but this year, owing to many causes, the Mint has been called upon to coin thirteen millions of gold, and more than three times the amount of silver moneys coined in 1870. This enormous increase in the supply of currency has only been met by immense exertion on the part of the authorities and workmen of the Royal Mint. Besides their labours to meet the public requirements of this country and trade generally, the Mint has been called upon to coin a large amount for the Colonies. We extract the following from the verdict, which was most satisfactory to the public and the Mint Authorities, and reflects great credit on Mr. W. Chandler Roberts, the Queen's Assay Master. "We then melted the said gold coins, making altogether 71 sovereigns and 6 half-sovereigns, so taken out and weighed, into an ingot, and assayed such ingot, comparing it with the Standard gold trial plate produced by the Board of Trade so as to ascertain whether the metal was within the remedy as to fineness prescribed in the said first schedule to the said Act; and we found that there was *no variation* thereof from the Standard of fineness specified in the said first schedule to the said Act." (The standard is 916·66. The ingot was 916·66 exactly. Coins would be legal if they contained 918·66 or 914·66 parts of gold in 1000·00 of alloy.) . . . . We then assayed six sovereigns and three half-sovereigns separately, and we found the millesimal fineness of such sovereigns to be 916·9, 916·7, 916·5, 917·2, 916·6, 916·6, respectively, and the millesimal fineness of such half-sovereigns to be 916·6, 916·6, 916·6, respectively.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, July 1, 1872.

This number contains no original papers relating to chemistry, but we quote the titles of the following interesting memoirs :—

Optical Phenomenon Observed During an Aërostatic Journey with an Air-Balloon.—G. Tissandier.—Illustrated by a woodcut.

Observations Made During an Aerostatic Journey with the Air-Balloon Named La Lea.—W. de Fonvielle.

July 8, 1872.

This number contains the following original papers and memoirs more particularly relating to chemistry :—

Influence of Pressure on the Phenomena of Endosmosis and Oxosmosis.—Dr. Becquerel.

Effects of Slow Action (Action Lente) Produced During a Number of Years.—Dr. Becquerel.—This paper contains the account of the results of some experiments which prove that, by slow but continued action, curious effects may be obtained; for instance—Crystals of arragonite are formed upon a piece of gypsum (lance-shaped variety) kept in a closed vessel in a solution of bicarbonate of potassa; the gypsum has almost entirely disappeared, having become converted into arragonite. A similar piece of gypsum, placed in a solution of arseniate of ammonia, has been converted into arseniate of lime. With a solution of aluminate of potassa and gypsum, the result is the formation of glauberite (double sulphate of lime and potassa, the latter substituted for the soda in the mineral just named). Pieces of galena, kept for twenty years in a solution of bicarbonate of potassa, have yielded well-defined crystallised carbonate of lead. When pieces of limestone were immersed into a solution of plombite of potassa (solution of oxide of lead in caustic potassa), the result was the formation of beautifully-crystallised hydrated carbonate of lead; malachite has been obtained by the action of limestone upon nitrate of copper, converting it into subnitrate, which, in its turn, is converted into malachite by bicarbonate of soda.

Dissolving Effect of Carbonic Acid upon Carbonate of Lime.—T. Schlœsing.—The second instalment of a lengthy memoir on this subject; this portion is elucidated by several algebraical formulæ and tabulated forms exhibiting results of researches.

Preparation of Aniline Colours.—Ch. Lauth.—The main gist of this paper is a refutation of an assertion made by Girard and De Laire, to the effect that the industrial manufacture of the aniline colours was highly dangerous and injurious, in consequence of the use of arsenic acid. The author of this paper says that, with due precautions, there is no danger either to the workmen engaged or to the neighbourhood of the colour-works.

Observations on Girard and De Laire's Paper on the Colouring Matter Derived from Diphenylamine.—Dr. Bardy.—This short paper is published with the view of establishing the author's priority of discovery in reference to methyl-diphenylamine, as proved also by his paper in the *Comptes Rendus*, vol lxxiii., p. 751.

Primary Spectrum of Iodine.—G. Salet.

Compressibility of Liquids under High Pressure.—L. Cailletet.—This paper contains the detailed account of a series of experiments, the results of which we quote in the following manner :—

	Density (Sp. gr.).	Temperature.	Compressibility.	No. of Atmospheres Pressure
Distilled water free from air	1·000	8°	0·0000451	705
Sulphide of carbon	—	8°	0·0000980	607
Alcohol	0·858	9°	0·0000676	174
		9°	0·0000701	305
		11°	0·0000727	680
Petroleum oil.. ..	0·865	11°	0·0000828	610
Petroleum essence (benzoline).. ..	0·720	10·5°	0·0000981	630
Sulphuric ether ..	—	10°	0·0001440	630
Sulphurous acid (fluid)	—	−14°	0·0003014	606

Analysis of a New Variety of Amblygonite from Montebras (Creuse), of the Amblygonite from Hebron (Maine, U.S.), and of the Wavellite from Montebras.—F. Pisani.—After referring to his former researches on this subject, and also to those of Des Cloizeaux, the author states that there exist two different varieties of amblygonite, viz., the lithico-sodic of Montebras and Saxony (Penig analysed by Dr. Rammelsberg), and the lithic amblygonite of Montebras and of the United States. The chemical composition of the Penig and Montebras varieties are quoted as follows :—Penig—Fl, 8·71; PhO_5, 47·58; Al_2O_3, 36·88; LiO, 6·68; NaO, 3·29; KO, 0·43. Montebras—Fl, 8·20; PhO_5, 46·15; Al_2O_3, 36·32; LiO, 8·10; NaO, 2·5; MnO, 0·40; HO, 1·10. The wavellite of Montebras consists, in 1 parts, of—Phosphoric acid, 34·30; alumina, 38·25; water, 26·6 fluorine, 2·27; total, 101·42.

Third Bichlorated Propylen.—C. Friedel and R. D. Silva.—this lengthy memoir the authors describe the results of their research which led to the discovery of a new bichlorated propylen boiling at 10 the formula of which is—

$$\begin{matrix} CH_2Cl \\ CH \\ CHCl \end{matrix}$$

The formulæ and boiling-points of the two other bichlorated propyl are—

$$\begin{matrix} CH_3 \\ CCl \\ CHCl \end{matrix} \quad 75°; \quad \begin{matrix} CH_2Cl \\ CCl \\ CH_2 \end{matrix} \quad 94°,$$

General Theory of Chemical Action; Two New Ac Obtained by the Oxidation of Sugar.—E. J. Maumené.—By limited oxidation of sugar by means of the cautious applicati permanganate of potassa, the author has obtained two new acids, wh

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he terms hexépic and trigenic acids; the formula of the former is $C_{12}H_{16}O_{16}$, and of the other $C_6H_8O_{10}$.

Aldehydes Condensed with Elimination of Water, or Aldanes.—J. Riban.—This lengthy monograph treats on the action of sodium and zinc upon the following aldehydes:—Acetic, valeric, benzoic, and aceton (this body is not acted upon by the metals just named at a higher temperature). The new substances which are formed from the aldehydes are termed by the author aldanes.

Thermo-Chemical Researches on the Bodies Formed by Double Decomposition.—Drs. Berthelot and Longuinine.—The third instalment of an exhaustive monograph; this part treats on the decomposition which the chlorides, iodides, and bromides of phosphorus undergo with water.

July 15, 1872.

Absence of Combustible Gases in the Fumes Emitted by the Caldeira de Furnas, at San-Miguel (Azores).—C. Sainte-Claire Deville.—The author has analysed the gases evolved with steam by the hot springs of the locality alluded to. It appears that only carbonic acid and sulphuretted hydrogen are present, whereas in the gases emitted with steam by the Geysers, in Iceland, hydrogen was found by Dr. Bunsen, and in the Lagoni of Tuscany hydrogen were detected by the author and M. Le Blanc.

Instantaneous Oxidation of Alcohol.—A. Houzeau.—By means of ozone, obtained by the apparatus invented by the author, absolute alcohol is in a few seconds converted into aldehyde and acetic acid, with formation of peroxide of hydrogen; ether is similarly acted upon by ozone.

Estimation of Urea by means of Millon's Reagent and the Mercurial Pump.—N. Gréhaut.—This physiologico-chemical essay contains the detailed description of a process of estimating urea by first converting it into carbonic acid and nitrogen, and then estimating the quantity of these gases.

This number also contains several important papers relating to physiology, geology, meteorology, and mechanical sciences.

Jahrbuch der Kaiserlich-Königlichen Geologischen Reichsanstalt, No. 1, 1872.

This number contains no papers strictly relating to chemistry, but we quote the titles of the following important memoirs:—

Ironstone Deposits of the Styrian Iron-Works Association.—F. Ritter von Hauer.—Illustrated with a map printed in colours.

Future of the Mining Industry in Austria.—C. Baron von Beust.

Added to and bound up with this number is a small volume, bearing the title of Mineralogical Notices, from which we quote the following:—

Chemical Examination of the Gopalpur Meteorite.—A. Exner.—The percentical composition of this stone was ascertained to be—Iron, 20·96; cobalt, 0·10; nickel, 1·80; sulphur, 1·74 (corresponding to 4·83 per cent of sulphuret of iron and 19·77 per cent of nickel-iron); silica, 37·44; protoxide of iron, 11·94; protoxide of manganese, 0·26; magnesia, 19·72; alumina, 2·52; lime, 1·60; potassa, 0·21; soda, 0·62; oxide of chromium, traces—of the last-named bodies, 28·63 per cent is soluble, and 45 67 per cent is insoluble, in hydrochloric acid.

Researches on Limestones and Dolomites as a Contribution to our Knowledge on Metamorphisms.—A. von Inostranzeff.—This essay, illustrated by a large number of engravings, contains the results of analyses of limestones and dolomites from various countries.

Polytechnisches Journal von Dr. E. M. Dingler, second number for June, 1872.

This number contains the following original papers and memoirs relating to chemistry, &c.:—

Description of a Dephosphorising Puddling Process for the Purpose of Preparing Good Malleable Iron from Pig-Iron which Contains Phosphorus.—Dr. T. Scheerer.—In the puddling process, the chlorides of calcium and sodium are used by the author for removing phosphorus from pig-iron. The quantity of the ingredients depends upon the quantity of phosphorus present in the pig-iron; supposing it is 2½ per cent, then the quantity of the chlorides to be added to a puddling charge of 3½ cwts. will be $=2\frac{1}{2}\times3\frac{1}{2}\times3=26\frac{1}{4}$ lbs. By the application of this process, a very good and fibrous malleable iron is obtained.

Change of a Bronze by having been for a Long Time Buried in the Earth.—E. Priwoznik.—This paper contains the account of some researches made with bronze ornaments found in an ancient burial-ground at Salzberg, near Halstatl (Austria). The composition of the metal was ascertained to be—Copper, from 90 to 92 per cent; tin, 6·5 to 9; in addition to these, small quantities of iron, arsenic, nickel, silver, cobalt, lead, and sulphur. The outer layer of the objects made of this metal, and buried in the earth for a very long time, was essentially found to consist of—Sulphur, 33·22; copper, 66·77 (the formula CuS requires—S, 33·54; Cu, 66·46). A second more inner layer was found to have been converted into Cu_2S, mixed with 15 per cent of tin, which is not met with in the outer layer. The third layer was found to consist of—Cu_2S, 59·8 per cent; tin, 23·2; water, 3·4; traces of antimony and nickel. None of these crusts or layers contained any lead, zinc, or silver.

Method of Obtaining Sugar from Molasses (Beet-Root).—M. Sebor.—The extensive report on an improved method of recovering from beet-root molasses the crystallisable sugar it contains; the process is based upon the use of saccharate of lime.

Effect of some Methods of Boiling Down Sugar Solutions in Vacuum-Pans.—E. Jicinsky.—The contents of this paper, elucidated by a series of tabulated forms exhibiting results of experiments made on the large scale, relate to practical sugar-refining.

Journal für Praktische Chemie, No. 10, 1872.

This number contains the following original memoirs and papers:—

Some New Derivatives of Albumen.—O. Loew.—Very-quickly-dried albumen has been treated with pure monohydrated nitric acid, care being taken to cool the mixture; the result is the formation of trinitro-albumen, the formula of which (that of albumen being taken as $C_{72}H_{109}N_{18}SO_{22}$) is—

$$C_{72}(NO_2)_3H_{106}N_{18}SO_{22}.$$

This substance is a yellow-coloured, tasteless, solid body, insoluble in water, alcohol, and ether, soluble in dilute alkaline liquids without decomposition, and precipitable from these solutions by acids; it is decomposed and carbonised by heat. This compound forms salts with lime and lead; the latter combination contains 31·01 per cent of lead. Another compound obtained by the author is oxytrinitro-albumen, a yellow-coloured solid substance, soluble in lime-water, and precipitable therefrom by means of alcohol.

Quantity of Water Contained in the Protosulphate of Iron and Ammonia.—Dr. E. Fleischer.—This essay reviews at length the results of the researches of Dr. Rheineck on this subject, and also contains the results of the author's experiments, which lead to the formula $FeOSO_3,NH_4OSO_3+6aq$ for the protosulphate of iron and ammonia.

Preparation of Propionic from Lactic Acid.—Dr. A. Freund.—This lengthy essay contains an account of a series of experiments made with the view of obtaining propionic acid directly from lactic acid by means of hydriodic acid. The author enters into a lengthy discussion on the by-products which are formed in this operation, and also on some of the derivatives of the propionic acid.

Chemical Composition of Maxite.—H. Laspeyres.—This paper treats on a new mineral, named maxite, found in the lead-mine of Mala-Culzetta (Island of Sardinia), and consisting, in 100 parts, of—CO_2, 8·082; H_2O, 1·866; SO_3, 8·140; PbO, 81·912. Formula—

$$5(PbO.SO_3)+9(PbO.CO_2)+4PbO.5HO.$$

Oxysulphide of Carbon.—F. Salomon.—The contents of this essay may be summarised as follows:—The salts obtained by Debus from xanthogenic acid ether, and by Bender from oxysulphide of carbon and alcoholic potassa solution, are identical, and are composed according to the following formula:—

$$(CS)^{OC_2H_5}_{OK}$$

The decomposition of the last-named salt, by means of hydrochloric acid, yields pure oxysulphide of carbon; this body may be prepared indirectly from oxide of carbon and sulphur, by causing the crude oxysulphide to be absorbed by alcoholic potassa solution, and next treating the ensuing crystalline compound with hydrochloric acid. It is not probable that there exist two isomeric oxysulphides of carbon.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 13, 1872.

On some Ketons.—E. Schmidt.—This exhaustive monograph treats at great length on the following bodies:—Aceton, CH_3COCH_3, boiling-point 56°. Propion, $C_2H_5COC_2H_5$, 100°. Butyron—

$$C_3H_7COC_3H_7,$$

144°. Valeron, $C_4H_9COC_4H_9$, 181° to 182°. Capron, $C_5H_{11}COC_5H_{11}$ 220° to 221°. Œnanthon, $C_6H_{13}COC_6H_{13}$, 264°. Caprylon—

$$C_7H_{15}COC_7H_{15},$$

178°. Methyl-capron, $CH_3COC_5H_{11}$, 155° to 156°.

Contribution to the History of the Phosphurets of Iron.—C. Freese.—While calling attention to Sidot's phosphuret of iron (see CHEMICAL NEWS, vol. xxv., p. 299), the author states that some five years ago he pointed out that such a phosphuret of iron (Fe_6P) does not exist (*Pogg. Ann.*, bd. cxxxii., p. 225), and the non-existence of this substance also upsets the theory of Maumené.

Estimation of Manganese in Pig-Iron, Steel, and Malleable Iron.—F. Kessler.—Reserved for full translation.

Reduction of Isoxylol and of the Aromatic Hydrocarbons in General.—F. Wreden.—After first referring at some length to the researches of Drs. Baeyer and Berthelot, the author states that he succeeded in reducing isoxylol by the aid of red phosphorus (amorphous) and concentrated hydriodic acid, these substances being placed in strongly-made glass tubes, which, after having been sealed, were heated for the first twelve hours to 170°, and for another twelve hours to 240°. The result of this operation, followed by a complicated process of purification, is the formation of a hydrocarbon, a mixture of C_8H_{16} and C_8H_{18}, in the proportion of 84·9 per cent of the former and 15·0 per cent of the latter.

Azophenylen from Para-Azobenzoic Acid (Azodracylic Acid).—A. Claus.—It appears that the azophenylen obtained from para-azobenzoic acid is identical with that obtained from azobenzoic acid. Azodracylate of lime yields, by dry distillation, a solid product, which, after having been purified, exhibits yellow-coloured needle-shaped crystals, fusing at 171°, and soluble in alcohol, water, and ether.

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Action of Cyanide of Potassium upon Iodide of Allyl.—A. Olaus.—This paper contains the account of the results of some experiments which are not yet completed, from which the author concludes that, by the reaction of cyanide of potassium upon iodide of allyl in sealed tubes, an acid is formed which is identical with pyrotartaric acid.

Indications of the Mercurial Calorimeter.—J. Thomsen.—The contents of this lengthy essay are chiefly written to prove that the mercurial calorimeter cannot yield constant and reliable results, and that therefore the experiments made by Favre, Valson, and others with this instrument, and the conclusions drawn from these experiments, are not correct.

Detection of Chlorine, Bromine, and Iodine in Organic Substances.—F. Beilstein.—The organic substances which contain these halogens—for instance, chloroform, iodmethyl, chlortoluol—are ignited in the blowpipe-flame, after having been placed on a small quantity of oxide of copper (kept by means of a small loop of platinum wire). The oxide of copper and halogen-containing organic substance yield a peculiar green or blue colouration to the blowpipe-flame.

Allyl-Alcohol Cyanide.—B. Tollens.—By causing a current of cyanogen gas to be absorbed by allyl-alcohol while warm, the author has obtained allyl-alcohol dicyanide, $C_3H_5(CN)_2OH$, a colourless fluid boiling at 151°.

Crystalline Forms of Dibenzyl and Stilben.—Th. Zincke.—A purely crystallographical essay, illustrated by several woodcuts.

On Terpen-Bibromide.—R. Biedermann and A. Oppenheim.—Terpen-bibromide yields, by oxidation with chromic acid (bichromate of potassa and sulphuric acid), terephthalic acid and a small quantity of a camphor-like substance containing bromine, probably the monobromhydrate oil of turpentine, $C_{10}H_{17}Br$.

Cymol from Oil of Turpentine and from Essential Oil of Lemons.—A. Oppenheim.—This essay contains the detailed account of a series of experiments to ascertain the real constitution of the essential oils by preparing from the same cymols. The cymols of terpen and citren boil respectively at 176° and 179°. The products of oxidation of cymol from terpen and citren are identical, being chiefly terephthalic acid.

Artificial Formation of Camphor.—A. Oppenheim.—While oxidising terpen-cymol, the author obtained a small quantity of a solid body which, on being analysed, proved to be camphor, which has thus been synthetically formed.

Some Derivatives obtained from Solid Dibrom-Benzol.—V. Meyer and C. Wurster.—This exhaustive monograph is divided into the following sections:—Action of ammonia upon nitro-dibrombenzol; phenyl-diamine from bromnitro-amidobenzol.

Formation of Sulphuric Acid and Urea, and the Behaviour of Taurine in the Animal Body.—E. Salkowsky.

Journal de Pharmacie et de Chimie, July, 1872.

The following original papers and memoirs are contained in this number:—

General Method of Immediate Organic Analysis.—Dr. Fleury.—The first instalment of an essay, illustrated by a woodcut exhibiting an apparatus for exhausting organic substances with ether, treating at great length on the immediate organic analysis. This part is divided into the following sections:—Estimation of water; treatment with ether.

Double Fusion-Point of a Vegetable Wax obtained from Japan, and on the Application of that Wax in Pharmacy.—Dr. C. Roucher.—The wax here alluded to is the product of the *Rhus succedaneum*, and is now a common article of commerce. It is harder than bleached bees'-wax, but more readily fusible. The fusing-point is stated to be at from 40° to 42°; but, on experimenting with two different samples, the author found that in reality the wax has two different fusion-points, for, on being heated cautiously from 40° to 45°, it does not become liquid, but simply softens, and remains opaque. On being further heated from 45° to 50°, it becomes transparent without becoming quite fluid; at 54°, however, the wax is quite molten. If suddenly heated to above its fusion-point, and, after having been somewhat cooled, it is placed in water at 42°, it again fuses, becoming quite fluid. The fusion-points are therefore 42° and 54°. Japan wax is not a solitary instance of this anomaly, since, according to Duffy, natural stearine (*stearine naturelle*), exhibits three modifications, fusing respectively, α at 51°, β at 63°, and γ at 66°. Bees'-wax fuses at from 62·5° to 64°.

Qualitative and Quantitative Analysis of a Mixture of Essential Oil of Bitter Almonds and Nitrobenzine.—E. Bourgoin.—The author uses caustic potassa (solid) as a qualitative test for detecting in essential oil of almonds the presence of nitrobenzine, which, if present, causes along with the potassa a reddish brown colouration of the originally yellow-coloured fluid; this colouration afterwards turns green. For the purpose of quantitative analysis, the suspected sample (some 5 to 10 grms.) is first mixed with from 20 to 40 grms. of a very concentrated solution of bisulphite of soda. This mixture is thoroughly shaken in a stoppered bottle large enough to hold at least 100 grms. of fluid; ether is then added, for the purpose of dissolving the nitrobenzine, and this ethereal solution is cautiously evaporated upon a water-bath and the residue weighed. The residue (nitrobenzine) may be further converted into aniline by the aid of acetic acid and iron filings.

Study on the Fluid Secreted in Pleuritis.—Dr. Méhu.—This paper treats on a medical, rather than a chemical, subject. It appears that the serous fluids secreted in various pathological pr contain about the same quantity of mineral salts—viz., f 9 grms. to the kilo. The sp. gr. of these fluids depends in upon the larger or smaller quantity of fibrine they contain.

Observations on Orange-Flower Water Distilled of Steam.—M. Vuaflart.—It appears that the practice of the water alluded to, by passing a current of steam over placed in a suitable vessel connected with a condenser, l rapid deterioration of this aromatic water; while the sa applies to rose and other similar waters used in pharmacy. states that aromatic waters prepared by the old method kee and are more agreeably flavoured than those submitted to th process.

Estimation of Phosphoric Acid in the Presence and Alumina.—A. Adriananzs.—The process of Dr. Chanc tion of phosphoric acid by means of bismuth) is modified by in the following manner:—To the chlorhydric solution of th in which the phosphoric acid is to be estimated hyposulph is added first, so as to reduce the peroxide of iron to proto nitrate of bismuth is added, and the vessel containing the heated for about four hours upon a water-bath. The precipi is formed is filtered off after twenty-four hours, and after h well washed is dissolved in nitric acid. The chlorhydric an acids present in this solution are next first eliminated by nitrate of silver and nitrate of baryta, while the phosph afterwards thrown down by means of nitrate of bismuth. phate of bismuth precipitate is collected on a filter, washed dissolved in chlorhydric acid and estimated as ammonio- of magnesia in the presence of citrate of ammonia. This p even be employed when the substance contains fifty ti alumina than phosphoric acid; but if the proportion of a very large, it is best to add to the substance a weighed pure phosphate of soda. If the iron might happen to be very large excess, it is necessary to re-dissolve the first bis cipitate and re-precipitate it a second time.

La Revue Scientifique de la France et de l'Etra July 6 and 13, 1872.

These numbers do not contain any original papers chemistry.

Les Mondes, July 25, 1872.

This number contains no original papers relating to che under the heading Bibliography we notice the followin "Premier Siècle de l'Academie Royale de Belgique," par M (grand 8vo.; Bruxelles: Hayes, imprimeur; 1872). The tinguished author of this work, who is perpetual secret Royal Belgian Academy of Sciences, Lettres, and Beaux A in this volume the history of the institution originally foun Empress Maria Theresa as sovereign of the then (1772) Netherlands.

NOTES AND QUERIES.

Glacial Sulphuric Acid.—Can any of your reader information as to price and names of manufacturers of sulphuric acid?—S. R. P.

Glue to Hold against Fire.—Mix a handful of qu 4 ozs. of linseed oil, boil them to a good thickness; then s tin plates in the shade, and it will become exceedingly har be easily dissolved over the fire, and used as ordinary glue.

Rendering Paper Sensitive to Electric Current.—inform me what is the best solution wherewith to saturat that the latter, when *dry*, will become sensitive (by decomp electricity, showing a blue or black mark wherever t passes? Ferrocyanide of potassum is unsuitable, because will not make a mark on it unless the paper is *damp*.—T. [There is no practical method of rendering *dry* paper the electric current, because dry paper is almost a non-co intense currents, and quite so to ordinary quantity currents. impressions may be obtained by employing extremely t upon which has been smeared starch-jelly (that used by la containing a few grains of potassium iodide, the electrodes on each side of the paper, and the current obtained from an coil giving, at least, a quarter-inch spark. With clean the first impression (the starch-jelly being dry) will prod good one, the second imperfect. But why not use dry p paper re-damped simply with water? With one electrode current from a single cell will then produce a clear impres

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TO CORRESPONDENTS.

H. E. W.—Salter's Edition of "Field's Chromatography

J. McL.—We believe a work on the subject was written in 1848. Consult also works on Forsenic Medicine.

A. H. Allen, E. Sonstadt, W. Chandler Roberts, B. J. Gu Crowder, Professor Galloway.—These correspondents are t their communications.

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THE CHEMICAL NEWS.

Vol. XXVI. No. 663.

ON METEORIC STONES.*

By NEVIL STORY-MASKELYNE, M.A., F.R.S.

The substantial unity of the celestial objects distinguished in common language by the names shooting or falling stars, fire-balls, and meteorites, and, further, the coincidence in many important respects of these with comets, and possibly with the zodiacal light, were suggestions made by Humboldt in the "Cosmos," which have received much confirmation from the subsequent advance of science.

The greater apparent velocity with which the ordinary meteors traverse the atmosphere as compared with that with which the less frequent larger bodies are seen to move, the marked periodicity that attends the recurrence of the former in several, and especially in two, notable cases of meteor showers, offer an apparent contrast between these classes of meteors; it is not, however, in all probability, a real contrast, for the one class passes into the other by every gradation in the magnitude of the mass or masses of which the meteor consists, and consequently in the grandeur of the phenomena which accompany its advent. If of the material composing the ordinary falling star we have never yet been able to recognise any vestiges as reaching the earth, of the meteorite, on the other hand, the mineral collections of Europe contain numerous carefully collected specimens, which are the fragments that have escaped the fiery ordeal of the transit through our earth's atmosphere, and in these we recognise masses composed either of iron (siderites), or of stones (aërolites), or of a mixture of the two (siderolites). The phenomena associated with such falls of meteoric matter have been described in very similar language by those who have witnessed them in various parts of the world, and these accounts, whether coming from European observers or from Hindoo herdsmen (of which some were read by the lecturer), concur generally in the approach of the meteorite as a fiery mass, emanating from a cloud when seen by day and exploding often with successive detonations that are heard over a great extent of country, even in certain cases at points more than 60 miles distant, but finally reaching the earth with a velocity little higher than what might be due to the motion of a falling body. Externally these meteoric masses are generally hot when they fall; sometimes, however, they are not so; the discrepancies in the accounts being explained by one authenticated case in which the mass was internally intensely cold, though at first hot externally. The fallen meteorite is invariably coated with an incrustation, sometimes shining as an enamel, generally black, but occasionally colourless where the aërolite is free from ferrous silicates; and this incrustation is seen to have been formed in the atmosphere, since it is found coating surfaces of fragments that have been severed by the explosions in the air.

Aërolites frequently fall simultaneously in large numbers, many thousands of them being in such cases spread over a surface of the country some miles in extent; and such showers of stones seem to have entered the atmosphere as a group, though their numbers must subsequently have been greatly increased by the division accompanying their detonation.

The explanation of the incrustation and of the cloud left by the meteorite, or out of which it seems to emerge, is found in the transformation into heat of the energy actuating a body that enters our atmosphere with a motion of 12 to 40 miles a second. The velocity of the body is almost instantaneously arrested by the atmospheric resistance, and in a very few seconds the mass becomes, comparatively speaking, stationary. Its surface must, as a consequence, be immediately fused, and the melted matter would be flung off from it into the surrounding air, fresh surfaces continually affording new fused material to form the cloud of, so to say, siliceous spray that lingers along and around the path of the meteorite.

When the mass is small,—and in the case of meteoric showers and ordinary falling stars it cannot exceed a few ounces, and may often be but a few grains,—the whole material is thus consumed, and must ultimately fall as an unperceived, because widely-scattered, dust. The meteorite is the residue that survives this wasting action where the magnitude of the mass is more considerable. The cause of the violent and often successive explosions is probably to be sought in the expansion of the outer portions of the mass, while the interior retains the contracted volume due to the intense cold of space with which the meteorite enters the atmosphere.

From time to time these contending conditions of volume may, as in a Prince Rupert's drop, produce explosion, the heated shell in the case of the meteorite flying off in fragments from the internally cold inner core, which if sufficient velocity remain to the mass will undergo a recurrence of the same conditions of surface fusion and explosion. The loudness of the detonation is also probably enhanced by the simultaneous collapse of the air on the vacuum that would follow the rapidly moving mass.

The pitted surface characteristic of meteorites probably bears witness to a similar effect of unequal dilatation operating more especially in the freshly-broken surfaces of the mass, small fragments splintering off in this way from the cold and brittle stone under the sudden influence of intense heat.

A remark made by Humboldt, that light and meteorites are the only sources of our knowledge regarding the universe external to our world, points to the true ground for our interest in the waifs and strays of extra-telluric matter that thus fall upon our globe.

In physical as well as in chemical characters aërolites resemble at the first aspect some terrestrial volcanic rocks.

The minerals of which they are composed are nearly entirely crystalline, as is evidenced by the colours in polarised light of such as are transparent. These minerals are usually aggregated with slight cohesion, and they present in by far the greatest number of cases a peculiar spherular or "*chondritic*" structure.

In these the spherules are composed of similar minerals to those which enclose them, and even contain metallic iron sometimes in microscopically fine grains disseminated through them.

A section of an aërolite was exhibited by the microscope in which some of the spherules had been broken before being cemented by the surrounding mass, and in another fissures were seen which had been filled with a fused material after one side of the fissure had slidden along the other; facts pointing to events in the history of the meteorite subsequent to its first formation.

The chemical composition and the mineral constitution of aërolites were illustrated by tables showing the elements met with in these bodies, and the minerals in which they were distributed. The former comprised about one-third of the known elements; among them magnesium, iron, silicon, oxygen, and sulphur were conspicuous; calcium, aluminium, nickel, carbon, and phosphorus coming next in importance, the basic elements of most importance by their amount being the same as those which are found by spectroscopic analysis to be present in the sun—and in those stars which have been the best examined.

The minerals most frequent in aërolites besides nickeliferous iron or troilite (iron monosulphide) and graphite,

* Read before the Royal Institution of Great Britain.

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are bronzite (a ferriferous enstatite) and olivine, both of the latter being essentially magnesium silicates. Augite and anorthite also occur (more particularly in the eukritic aërolites of Rose) and some minerals unknown in terrestrial mineralogy have also been met with; such are the different varieties of Schreibersite (phosphides of iron and nickel); calcium sulphide, asmanite (a form of silica crystallising in the orthorhombic system and having the specific gravity of fused quartz), and a cubic mineral with the composition of labradorite. The crystalline form of bronzite was first determined from the crystals in a meteorite, and was found to confirm the conclusion Descloizeaux had arrived at as regards its system from observations on the distribution of the optic axes in the terrestrial bronzite and enstatite.

The question as to whence the meteorites come is one that we are not yet in a position to answer with certainty. The various hypotheses which suppose for them an origin in lunar volcanoes, or in our atmosphere, or again in a destroyed telluric satellite, or that would treat them as fragments of an original planet of which the asteroids are parts, or as masses ejected from the sun; all these hypotheses seem to be more or less precluded by the known velocities, the retrograde motion so frequently chacterising meteors and meteorites, or else by the chemical conditions that, for instance, are involved in the passage of the meteorite through the sun's chromosphere. Whether meteorites move or do not move in circumsolar orbits is at present impossible to say; because, while with our incomplete knowledge we cannot to-day attach the character of periodicity to any known class of meteorites, we are not justified in founding any conclusion on a negative result with so limited a foundation.

But even if all or some of them may have been, on their encountering the earth, members temporarily or permanently of the solar system, we may with considerable probability consider them as having originally entered our system from the interstellar spaces beyond it. Such at least must be our conclusion if we are to admit the unity of the whole class of phenomena of meteorites and falling stars. For, since the orbits of the two best known meteoric streams, those namely of August and November, have been identified with the orbits of two comets, and since in regard to one of these (that of November) Leverrier has shown, with great probability, that as a meteoric cloud it entered and became a member of our system only some 1700 years ago in consequence of the attraction of Uranus, while the August meteoric ring only differs in this respect from it, that it had at a much more remote period found an elliptic orbit round the sun: we are constrained on the assumption with which we started to recognise also in a meteorite a visitor from the regions of remote space. And so far as it goes, the observation by Secchi that the November falling stars exhibit the magnesium lines is in harmony with this view.

It may, however, further be said, that the tendency of scientific conviction is in the direction of recognising the collection towards and concentration in definite centres, of the matter of the universe, as a cosmical law, rather than the opposite supposition of such centres being the sources whence matter is dispersed into space. In the meteorites that fall on our earth (certainly in considerable numbers) we have to acknowledge the evidence of a vast and perpetual movement of space, about which we can only reason as part of a great feature in the universe which we have every ground for not supposing to be confined within the limits of the solar system.

That this matter, whether intercepted or not by the planets and the sun, should to an ever-increasing amount become entangled in the web of solar and planetary attraction, and that the same operation should be collecting round other stars and in distant systems such moving "clouds" of star-dust as have been treated by Schiaparelli, Leverrier, and other astronomers, or individual masses of wandering stone or iron, is a necessary deduction from the view that we have assumed regarding the tendency of cosmical matter to collect towards centres. But in order to trace the previous stages of the history of any meteorite, and, in particular, to determine the conditions under which its present constitution as a rock took its origin, we have only for our guide the actual record written on the meteoric mass itself; and it is in this direction that the mineralogist is now working.

But the progress is necessarily a gradual one. We may indeed assert that the meteorites we know have, probably all of them, been originally formed under conditions from which the presence of water or of free oxygen to the amount requisite to oxidise entirely the elements present were excluded; for this is proved by the nature of the minerals constituting the meteorites and by the way in which the metallic iron is distributed through them.

And one suggestive and significant fact remains to be alluded to; the presence, namely, in some few meteorites of combinations of hydrogen and carbon, with if met with in a terrestrial mineral would with little hesitation be assigned to an organic origin. A few grains were exhibited to the audience of such a body, crystallised from ether, which solvent had extracted it to the amount of about 0·25 per cent from 6 ozs. of the Cold Bokkveldt meteorite.

Similar substances have been extracted by Wöhler, Roscoe, and other chemists from this and other meteorites. It was, however, observed, as pointing to the probability of the comparatively porous meteoric stone having in this case taken up the hydrocarbon as a substance extraneous to it (possibly when in the state of a vapour), that ether extracted it entirely from the solid lumps of the meteorite; pulverisation not in any way adding to the amount obtained, or facilitating in any appreciable degree the separation of the substance.

CHEMICAL PRODUCTS OF EUCALYPTUS.

The valuable character of this plant is becoming more and more appreciated as its properties are better known; and this is more especially the case since its first introduction into Europe from Australia by M. Ramel in 1856. In Southern Europe it is easily acclimatised, though, in districts so far north as Paris, the winter has been found too severe for it. In Australia and Tasmania it is very abundant. Its growth is very rapid; the leaves and the roots have a very great absorbent power for moisture; and this fact, together with the aromatic odour from the leaves, makes the tree peculiarly suitable for marshy and unhealthy districts.

In the *Moniteur Scientifique Quesneville*, M. Papillon discusses the various properties of *Eucalyptus*, and gives the following particulars as to chemical and pharmaceutical preparations obtained from the plant:—

M. Cloëz has studied the chemical properties of *Eucalyptus*. He first sought to know what proportion of essence of *Eucalyptus* could be obtained from the leaves. 10 kilos. of fresh leaves, taken from branches killed by frost in the end of 1867, furnished, on distillation with water, 275 grms. of essence, or 2·75 per cent. 8 kilos. of dry leaves, gathered, after a month, at Hyeres, produced 489 grms. of essence, or a little more than 6 per cent. From leaves that were completely dry, having been brought from Australia five years previously, about 1·5 per cent of essence was obtained.

This essence is a very fluid liquid, slightly coloured, and giving an aromatic odour which reminds one of camphor. Heated in a distilling apparatus, it commences to boil about 170°. The thermometer rises rapidly to 175°, where it remains till about half the product has passed in distillation. Another portion of the essence passes between 188° and 190°. By further application of heat, a small quantity of volatile liquid is obtained at a temperature slightly over 200°.

The liquid distilled between 170° and 178° is not a

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pure product. On rectifying with potash and chloride of calcium, a very fluid colourless liquid is obtained, which boils at 175°, and which M. Cloëz calls *Eucalyptol*. It is much lighter than water; its density is 0·905, and it turns the plane of polarisation to the right. It is soluble in alcohol, but only very slightly so in water. Its composition, according to M. Cloëz, is $C_{24}H_{20}O_2$. When treated with nitric acid, one of the products of the reaction is a crystallisable acid, probably analogous to camphoric acid. Another product, obtained by distillation of eucalyptol with phosphoric anhydride in a retort, is *Eucalyptene*, a hydrocarbon with the formula C_2H_{18}. A further product, obtained by the action of phosphoric anhydride, is called by M. Cloëz *Eucalyptolene*.

Besides the essence eucalyptol, to which the *Eucalyptus* largely owes its medicinal properties, it contains a solid, resinous, bitter principle, little known as yet, from which the leaves derive their febrifuge qualities.

The following preparations, &c., are at present manufactured from *Eucalyptus*:—

(1). The essence already spoken of, and which is administered in doses of a few grms. in the form of globules.

(2). Leaf powder, which contains all the active principles of the plant (essence, tannin, bitter principle), and which is prescribed in doses of 4, 8, 12, and even 16 grms. daily.

(3). The infusion and decoction of the leaves. With half a leaf (about 1 grm.) it is possible to aromatise three or four cups, affording a good substitute for tea, employed as a stimulating drink. For topic applications, 8 grms. in decoction, in a litre of water, forms a liquor well charged with the principles indicated.

(4). Water distilled from the leaves, which may be advantageously used with stimulating drinks.

(5). Aqueous extract, alcoholic extract, employed as febrifuges.

(6). Tincture, or alcoholate.

(7). A liquor, which is similar to the liquor of mastic, and a wine, which is a tonic and febrifuge.

(8). Cigars and cigarettes.

Dr. Gimbert has studied, on himself, the effects of essence of *Eucalyptus* when taken into the system. He took various doses of from 10 to 20 drops. He found it had a soothing effect. It diminishes the vascular tension, and the sense of comfort arising from it induces to sleep. A very strong dose produces a temporary excitement, headache, and slight fatigue.

A. B. M.

ASSAY OF PYRITES FOR GOLD.

By J. M. MERRICK, S.B.

THE following described method has been employed by myself for more than a year, and found to work well enough to merit description.

One pound, or even 18 ounces (avoirdupois), of fine marble-dust is mixed with 8 ounces of finely-pulverised and sifted pyrites; the whole then re-sifted and put into a Hessian crucible, which should be about one-third filled by the mixture. The crucible is set as usual on a fire-brick, and a fire of hard coal is made around it, the coals being heaped up to within an inch of the top. The crucible is covered with a piece of brick or a piece of sheet-iron. During the first half hour the contents should be stirred once or twice. As the fire grows brisker the carbonic acid evolved keeps the contents of the crucible in brisk ebullition, and the mixture should be stirred well every 5 or 10 minutes. On stirring during this time, the iron rod used seems to meet with but little resistance from the light mass, but at the end of about 1½ hours the evolution of gas suddenly ceases, the red-hot mass becomes heavy, sinks, and requires considerable force to keep it stirred. It must be stirred well and vigorously, however, for about ½ an hour, not leaving it unstirred for more than a minute, otherwise the mass will fuse or cake, and the assay will be almost inevitably ruined.

When a sample taken out in an iron spoon gives off *no* smell of sulphur, the entire contents of the crucible must be turned into a stoneware pot or a wooden bucket half-filled with water, and well stirred. When the powder—which should be uniform and free from lumps or fused pieces—has settled, the water must be poured off, the wet mass allowed to drain, and then transferred to a large earthen bowl or porcelain mortar. Here it is to be amalgamated with about 2 ounces of mercury, to which a little bit of sodium amalgam has been added. The amalgamation, as well as the stirring in the fire, is a tedious process, and one which I prefer to do by proxy. It does not consist in merely grinding with a pestle the mercury in among the particles of the roasted ore, but this ore itself must be ground in contact with the mercury, until the particles are so fine that they will float suspended in water for several seconds. At the end of—say—10 minutes thorough grinding, the contents of the bowl are to be brought into one mass in the bottom of the vessel, the bowl then sunk in a tub of water, and the contents "washed down,"—an operation not easily described, but familiar enough to every old Californian. It consists essentially in shaking the bowl half-full of ore amd water in such a way that the mercury, gold particles, and unground ore sink to the bottom, while the light and finely-ground ore is floated off into the tub. The ore remaining is re-ground and re-washed, and these processes are repeated till nothing but the mercury remains in the bottom of the bowl or mortar. This mercury is then dried with filter-paper, and heated in a porcelain capsule over a Bunsen flame, very gently, until it is sublimed and the gold remains behind. The film of gold may then be scraped up and melted, with a little sodic borate and potassic nitrate, in the very smallest-sized Hessian crucible, either with the foot blowpipe or in a charcoal furnace, by which means a round, clean button of gold, suitable for weighing, will be obtained.

This method—which I have subjected to a most thorough trial, my experiments having been made almost daily for 3½ months—has its disadvantages and its counterbalancing merits. On the one hand, it must be admitted to be tedious, laborious, and to a considerable degree uncertain. Some analysts fail with it altogether, while none who have tried it, so far as I know, get closely agreeing results.

But on the other side, it is certain that this method will indicate the presence of gold, and will bring out the gold in a weighable form from pyritic ores, where the assay by smelting will not show a remote trace of the precious metal; and that where the fire assay shows a certain percentage this will invariably bring out a larger amount. I have obtained large returns by this amalgamation method from iron pyritic ores, which have been repeatedly assayed in the ordinary way, by chemists of great eminence, with uniformly negative results.

It may be added, that while on this side of the water the existence of gold in any workable amount in iron pyrites is strenuously denied by the ablest assayers, the Wicklow pyrites are worked for gold and silver, as by-products to be sure, but in quantities sufficient to pay.

That no gold has been discovered by many assayers in pyritic ores, which have yielded me large results, I refer to the volatility of gold in the presence of sulphur. I imagine that the gold is roasted off in the very first step of the ordinary process. See Crookes and Röhrig's "Metallurgy," "Gold," pp. 629—630, and the authorities there quoted.

I have had no opportunity to put this method in practice on a large scale, and I hardly know what kind of stirring apparatus could be devised; but I have seen 20-lb. lots of ore thus roasted and stirred by hand-power, with satisfactory results.—*American Chemist.*

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THE ANALYSIS OF WATERS IN INDIA.*

By EDWARD NICHOLSON, F.C.S.,
Assistant Surgeon R.A., Analyst of Waters, Mysore, Northern and Ceded Districts.

The Fallacy of the New Bengal Method.

Since I last wrote on this subject, a new scheme of water analysis has appeared, in supersession of the Bengal and Madras schemes. This new scheme was compiled by Dr. Macnamara, Chemical Examiner to the Bengal Government, he having been charged, at his own request, with the production of a scheme for general use in India. A uniform scheme was desirable, even if only for the reason that the Bengal and Madras schemes differed essentially; for instance, the Bengal analysts (Dr. Macnamara's first scheme) were required to give chloride of sodium, sulphate of soda, and carbonate of soda as the three "soluble" salts existing in waters, whilst the Madras form (Dr. King's) ordered calcium sulphate, magnesium sulphate, and sodium (as sulphate) to be the three "soluble" salts. Both schemes, however, agreed in three being the number of the "soluble" salts that should be present in waters; *Numero deus impare gaudet.*

The new scheme has judiciously abandoned this artificial method of statement, and has adopted to a great extent the principle of the natural statement I mentioned in my last paper on this subject. It will be remembered that I advised strict adherence to the principle of stating the actual radical substances found in the water, without reference to the processes by which the results were obtained, and relegating to the column of remarks any empirical formula or statement of the combinations in which the radicals were supposed to exist. I showed that, by doing so, uniformity and economy of tabular space was secured, whilst no element of inaccuracy was introduced; processes could be left to the individual skill of analysts, and, if necessary, improvements could be introduced without interference with the form of statement. The whole information could be given in twenty columns.

In the scheme now ordered for adoption, this principle of natural statement has unfortunately been spoiled in practice, as the statement of the quantitative analysis has been mixed up with one (or rather two) of qualitative analysis, besides, of course, the soap test. The resulting forty-six items of information are divided into three portions; the first of these is for use in ordinary cases, and in it only two of the substances found in water (chlorine and sulphuric acid) will be stated, the rest of the report being occupied by the recital of a prolix and inaccurate qualitative examination. The remaining items of the quantitative analysis are reserved (facultatively) for extraordinary occasions; which is to some extent fortunate, as the performance of the analysis *in extenso* would occupy at least a fortnight in a well appointed laboratory; how long it would take when the analyst is working "in such accommodation as a dâk bungalow or spare barrack-room can furnish"† I will not undertake to say.

The following is the detail of the "chemical analysis." I have divided it into three columns, according to the division allowed in the scheme.

I. The part of the examination to be made in all cases.

II. The additional examination to be added under the following conditions:—(1) In the case of any exceptionally important water sources; (2) when the foregoing examination leaves any doubt as to the character of a water; (3) in the case of two water sources of any station, and of a larger number if many water sources have to be examined in any station; (4) in other cases which the Chemical Examiner at that Presidency thinks proper.

III. The further examination to be made at the discretion of the analyst or at the request of the Chemical Examiner of the Presidency.

I.	II.	III.
	Qualitative Analysis.	
(*a*). Of unconcentrated water.		
1. Reaction.		
2. Free carbonic acid.		
3. Sulphuric acid.		
4. Nitric acid.		
5. Nitrous acid.		
6. Chlorine.		
7. Sulphuretted hydrogen.		
8. Lime.		
9. Iron—ferrous or ferric salt.		
10. Lead, or other heavy metals.		
11. Ammonia.		
(*b*). Of water concentrated to one quarter of its original bulk.		
1. Reaction.		
2. Nitric acid.		
3. Phosphoric acid.		
4. Silicic acid.		
5. Iron—ferrous or ferric salt.		
6. Magnesia.		
	Quantitative Analysis.	
A. Of suspended matter.		
		1. Total amount per litre.
		2. Combustible matter per litre.
B. Of dissolved constituents of the water.		
(*a*). Hardness.		
1. Total.		
2. Removable.		
3. Permanent.		
(*b*). General Analysis.		
1. Total solids per litre.		
2. Effects of ignition.		
		3. Silicic acid.
		4. Oxide of iron, alumina, phosphoric acid.
	5. Lime.	
	6. Magnesia.	
		7. Alkaline chlorides.
		8. Potassium chloride.
		9. Sodium chloride.
10. Chlorine.		
11. Sulphuric acid.		
		12. Combined carbonic acid.
	13. Nitric acid.	
	14. Nitrous acid.	
		15. Phosphoric acid.
		16. Sulphuretted hydrogen.
	17. Ammonia, free, and of salts.	
	18. Albumenoid ammonia.	
19. Oxygen removed by readily oxidisable matters.		
20. Oxygen removed by oxidisable matters of water heated to 60° C.		
(*c*). Measurement of gaseous constituents.		
		1. Of nitrogen (corrected for 0° C.) from 1 litre.
		2. Of oxygen.
		3. Of carbonic acid.
		4. Oxygen and nitrogen taken at 100, state proportion of oxygen.

The scheme does not merely give a form of statement for physical and chemical examination; it retains the principle of enforcing certain processes for the determination of the items in the above form, a principle open to objection even if the processes are sound, but most injudicious when, as in the present case, any one of chemical experience can see that the processes are more often bad

* Communicated by the Author.

† The circumstances in view of which this scheme is stated to have been specially devised.

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than good. If the analysts are competent for the delicate analytical work involved in measurements of gases, &c., there is no need to lay down rules for them to go by; an analyst of this experience would resent such unnecessary interference, just as the executive medical officer would resent any orders as to the treatment he should adopt in his hospital. If the analysts require to be taught their work, it would be better to place in their hands some respectable manual of analysis, and confine the scheme to an elementary hygienic examination until they shall have learnt by experience.

The processes laid down in this scheme might be useful if they were ordinarily sound, but they unfortunately bear evident traces of being derived, some from books of reference, others neither from books nor from practical experience. It may seem that I am using hard words, but it is no longer time, at the third bad scheme, to deal gently with such grave offences against science.

Taking the second item in the qualitative analysis, I find the following process laid down for the guidance of the analyst.

"*Free Carbonic Acid.*—Pour a little of the water into about 5 c.c. of lime-water contained in a test-tube. If free carbonic acid is present, the precipitate of carbonate of calcium which first forms will re-dissolve on the addition of a large quantity of water."

I thereupon take a rather large-sized test-tube (holding about 30 c.c.). I pour in 5 c.c. of lime-water, and add a little (say 10 c.c.) of the water to be examined. A white precipitate appears, which increases on the addition of more water; the test-tube being full, I continue the experiment in a large beaker; I go on adding the water until I have added half a litre, yet the precipitate does not re-dissolve; by the time I have added a litre the precipitate becomes less perceptible in the large bulk of water, but it has certainly not re-dissolved. Water after water gives the same result. Even a water to which I add 10 per cent of fresh soda-water (sufficient to make it taste distinctly of carbonic acid) fails to produce, in the test-tube, the promised reaction.

The reason is obvious. The 5 c.c. of lime-water contain about 0·50 centigramme of lime ($\frac{1}{100}$); this quantity requires 0·89 centigramme of carbonate of lime, held in solution as bicarbonate, to precipitate it entirely, a reaction which must be accomplished before free carbonic acid can have any re-solvent effect on the precipitated carbonate of lime. Now a water of ordinary calcareous type containing 8·9 centigrammes per litre (6·2 grs. per gallon) would have to be added to the amount of 100 c.c. before the precipitation was complete; and it would require a water to contain no less than 89 centigrammes per litre (62 grs. per gallon) of carbonate of lime for 'a little of the water,' say 10 c.c., to complete the precipitation of the lime contained in 5 c.c. of lime-water. I can find no instance of a potable water containing an amount of carbonate of lime even approaching to this. So we find that a large-sized test-tube will be full long before any free carbonic acid has the slightest chance of re-dissolving the precipitate. When the precipitation is complete, it is doubtful whether it would be re-dissolved by the small amount of free carbonic acid that could be found in a potable water. The author of the scheme has evidently not very clear notions as to what is meant by free carbonic acid; what is often considered as such is not free, being the unstable carbonic acid holding up the carbonate of lime; any excess beyond that necessary for this purpose can only be present in minute quantity; and its detection would certainly not be effected by the process laid down, even were the largest sized vessels substituted for the test-tube ordered to be used.

Passing to the qualitative examination of the concentrated water, the following directions are given:—"About 200 c.c. of the water should be evaporated to one-tenth its bulk, and then tested, as regards its reaction and the presence of nitric acid and iron in the manner already described." The concentrated water is apparently filtered; no direct mention is made of this, but I infer it from the subsequent words: "*Magnesia*—To 10 c.c. of the filtrate," &c. Now I may here observe that the result of the concentration will be to deposit the greater part of the earthy carbonates, perhaps some silicates, and whatever phosphoric acid and iron the water contained. So the analyst on examining the concentrated water will find—(1) that the reaction is alkaline, just as it was before concentration; (2) that the nitric acid is present or absent, just as it was before concentration; (3) that the iron, if present before, has now disappeared, saving him the trouble of ascertaining its condition as a "ferrous or ferric salt." The first two results are of questionable utility, whilst the third will probably be unexpected and productive of some perplexity. The analyst having wasted his time in this manner and searched for magnesia in the filtrate (it is to be hoped that it has not gone all down in the deposit), is directed to proceed as follows:—

"The portion of concentrated water which remains must be tested for phosphoric acid. Add a slight excess of hydrochloric acid, evaporate to dryness in a platinum capsule, and ignite in order to render any silicic acid insoluble. Treat the residue with about 1 c.c. of dilute nitric acid, filter, and mix the filtrate with an equal bulk of solution of molybdate of ammonium and about half the quantity of pure strong nitric acid. If phosphoric acid is present, a yellow crystalline precipitate will form immediately or after a short time."

In the absence of any specific directions, the analyst will naturally take the rest of the filtrate after using some for magnesia, &c.; he will operate as directed on these 20 to 30 c.c. of concentrated water, and after much trouble he will invariably find nothing. Even if he disregarded the instructions and took the precipitate instead of the concentrated water, he would not be much better off; 200 c.c. of water are not nearly sufficient for the detection of the very minute quantity of phosphoric acid usually present in water, and, moreover, the molybdate of ammonia process ordered is one of the most untrustworthy known. However, the certain non-appearance of phosphoric acid in the above-indicated process will be compensated by the probable appearance of platinum; for if the water contain nitrates in at all notable quantity, evaporation with hydrochloric acid will hardly fail to attack the platinum capsule;* so that in the following note: "*Silicic acid*—The residue undissolved by nitric acid may be looked upon as silicic acid," it would perhaps be more correct to read *platinum* for *silicic acid*.

(To be continued.)

ON DYES AND DYE-STUFFS OTHER THAN ANILINE.†

By Dr. F. CRACE CALVERT, F.R.S.

(Continued from p. 55).

Blue Colouring Substances.—Indigo, Orchil, Cudbear, Litmus, Prussian Blue, and Ultramarine.

Indigo.—This most valuable dyeing substance was used as a dye-stuff in India and Egypt long before the Christian era, and the Romans were acquainted with it, although they only used it as a pigment, not knowing how to render it soluble, and so available for dyeing. It is only since the sixteenth century, or from the time of the discovery of the passage to India round the Cape of Good Hope, that it has become generally known in Europe; and its employment as a dye was greatly retarded by the opposition it met with from the large vested interests of the woad cultivators, who induced

* If the nitrous waters of India are thus treated, this accident will occur. I have had a platinum capsule attacked to the extent of half a grain.

† The Cantor Lectures, delivered before the Society of Arts. Revised and communicated by the Author.

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the English, French, and German governments to promulgate several enactments against its use. So severe were some of them, that Henry IV. of France issued an edict, condemning to death any one who used that pernicious drug called the "devil's food." It is only since the year 1737 that the French dyers have had the right of using indigo without restriction.

Indigo exists in several varieties of plants, among which may be mentioned the *Polygonum tinctorium* and the *Isatis tinctoria*, or woad; but, as in the case of nearly all the dye-stuffs already spoken of, it is found most abundantly in plants of the leguminous order. It is extracted commercially from the genus *Indigofera*, varieties of which are cultivated in India, Java, China, and in some of the South American States.

To extract the indigo which the plant contains, it is mowed when in full flower, made into bundles, and carried into large vats containing water. Fermentation ensues, which is allowed to proceed for eight or nine hours, when the liquor, which was yellow at the beginning of the operation, assumes a dark green colour, forming a blue scum on the surface. This liquor is then run off into shallow vats, where it is violently agitated with sticks, stirred by men or women or with a dasher, which produces the same result, the conversion of the white soluble indigo into blue insoluble indigo. A little lime-water is now added, and the whole allowed to rest. The blue indigo thus deposited is boiled with water, when a scum, composed of vegetable and animal matters, comes to the surface, and is removed. The blue paste is thrown on a filter, pressed, and placed in wooden frames, which are divided into small squares, where the indigo is allowed to dry first in the sun and afterwards in the shade. The quality of the indigo produced depends mainly on the care bestowed on its manufacture.

Until 1855 we had no correct ideas as to the state in which the indigo existed in the *Indigofera* plants, nor of the changes which it underwent during the process of extraction. It had been stated by M. Chevreul, many years before, that white indigo was oxidised into blue. But in the above year, and subsequently, in 1857 and 1865, Dr. Schunck published a series of papers, in which he described the true nature of the chemical changes which take place in the manufacture of indigo. He operated on the *Isatis tinctoria*, or woad, which contains the same colour-giving principle as the *Indigofera*, and is the only plant yielding indigo that grows freely in this country.

By these researches, he demonstrated that indigo existed in the plants, combined with a sugar, forming a glucoside, to which he gave the name *indican*; this compound, under the influence of fermentation in the manufacturing process, was unfolded into indigo and sugar. By treating the dried woad with ether or alcohol, Dr. Schunck obtained indican, and, among other processes for its extraction, gives the following simple one. He treats the pounded dried woad leaves with ether in a displacement apparatus, and distils off the greater part of the ether. The remaining green liquor is then evaporated at a moderate temperature, a little cold water added to the syrupy residue, and the insoluble chlorophyl and other matters separated by filtration. The yellow liquid thus obtained is evaporated, either spontaneously or *in vacuo*.

Indican is a yellow, transparent, glutinous solid. As may be seen from the above, it is soluble in alcohol, ether, and water. When boiled with caustic alkalies, it evolves ammonia, but its most remarkable and interesting property is that of yielding indigo blue when treated with strong acids. If sulphuric or muriatic acid be added to its water solution, no change whatever is perceptible for some time. But on heating to near the boiling point, the solution immediately becomes sky-blue. On boiling for a short time, the solution becomes opalescent. On continuing to boil, it acquires a purple colour; and then, provided the solution is tolerably concentrated, a copious deposit of dark purple flocks is formed. These are collected on a filter, and washed with water. By treating the washed flocks with alcohol, Dr. Schunck obtained pure indigotine, and a reddish blue substance was dissolved, called by Berzelius indigo-red, and by Schunck indirubine, which may be considered as a product of the decomposition of indican.

The colour-giving principle of the plant may be considered, like those of the dye-woads, as a glucoside, yielding by its decomposition a colourless principle, which is afterwards converted into a colour. Dr. Schunck explains by the following formula the decomposition of indican into indigo:—

$$\underset{\text{Indican.}}{C_{26}H_{33}NO_{18}} + \underset{\text{Water.}}{H_2O} = \underset{\text{Indigo.}}{C_8H_5NO} + 3\underset{\text{Indiglucine.}}{(C_6H_{10}O_6)}.$$

In 1864 he published a most valuable paper, throwing much light on the manufacture of indigo, and the management of what is called a woad vat. In it he gives the chemical actions which take place, and explains why, if the indigo manufacturer does not take the greatest care in conducting the process of fermentation, to extract the indigo from the plant, he will either get an inferior quality of indigo, or a great decrease in the yield of the product, or even in some cases entirely lose the colouring matter. He shows that these results take place when the fermentation in the vats is allowed to be either too rapid or too prolonged, in which cases not only is indican decomposed, but the *indiglucine*, or sugar, is converted into alcohol and acetic acid; and he shows that the indigo combines with this alcohol and acetic acid, yielding a compound which does not permit the indigo it contains to be oxidised on exposure to the air. This explains the loss of indigo in its manufacture. Dr. Schunck represents the change by the following formulæ:—

$$\underset{\text{Indigo.}}{C_8H_5NO} + 8\underset{\text{Alcohol.}}{(C_2H_6O)} + 3\underset{\text{Acetic Acid.}}{(C_2H_4O_2)} + CO_2 = C_{31}H_{39}NO_4 + 13H_2O.$$

He produced this compound more easily by treating pure indigo blue with alcohol, to which was added an alkaline solution of protoxide of tin, until the indigo was dissolved, acetate of soda was then added, and the whole digested at a moderate temperature. The indigo blue after some time ceased to be deposited on exposure to air, having entirely disappeared, having been converted into the new compound.

Pure indigo, or indigotine, can be prepared from indican by the process already described, or by reducing indigo to powder, placing it in a small dish on which is a cover, and applying a heat of about 300° or 400° Fahr., when beautiful prismatic needles of indigotine are sublimed, which are removed mechanically. It is insoluble in water, alcohol, or ether, or in weak acids, or alkalies, but is slightly soluble in creosote, carbolic acid, and anhydrous acetic acid, to which a very small quantity of sulphuric acid has been added. From this latter solution, the indigotine may be precipitated by the addition of water. It is the only solution of blue indigo that can be applied directly on a fabric.

Indigotine, when heated, gives off beautiful violet vapours, having a characteristic odour. Under the action of oxidising agents, such as nitric acid, it yields three distinct products, *isatin*, $C_8H_5N.O_2$; *indigotic or nitrosalycilic* acid $C_7H_3(NO_2)O_3$, and picric acid, $C_6H_3(NO_2)O$. The first is formed by simple oxidation, whilst in the second and third, part of the carbon is oxidised, and hyponitric acid is substituted for part of the hydrogen. These chemical reactions lead me to call your attention to some very interesting scientific deductions, showing indigo to bear a very close relation to aniline and carbolic acid, both products derived from coal-tar. If indigotine is heated with potash in a small retort, aniline is produced, and distils over. When indigo is heated for some time with caustic potash solution of specific gravity 1·35, it yields anthranilic acid, which may be considered as a

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phenyle-carbamic acid. Anthranilic acid, again, being heated to 570° F., gives salycilic acid, which may be considered as a compound of carbonic with carbolic acid. Lastly, indigotine, like carbolic acid, yields on treatment with excess of nitric acid, picric or trinitrophenic acid.

These facts have produced on the minds of chemists a conviction that indigotine will one day be artificially prepared from carbolic acid, and recently MM. Emmerling and Engler have accomplished the scientific artificial production of indigotine from a compound acetone, discovered in 1857 by M. Friedel, to which these gentlemen have given the name of acetophenone. Their process consists in acting on this compound with fuming nitric acid, when two nitro-compounds are produced, one crystalline, the other syrupy. To the latter, after its evaporation to the state of a resinous mass, they add ten parts of reduced zinc and one part of soda-lime. The mixture is heated in small tubes, when a little water evaporates and a dark-coloured substance sublimes, which contains indigotine in small quantities. This result is certainly a triumph of scientific chemistry, and brings us another stage nearer the commercial artificial production of a most valuable dye.

A great variety of substances, by adding one equivalent of hydrogen, convert blue indigo into white indigo, which is a colourless substance, without taste or odour, insoluble in water, but soluble in alcohol and ether, and in solutions of the alkalies and alkaline earths. On this point I may observe that, many years ago, I devised a process, by which many pounds worth of indigo were recovered from the refuse bottoms of the blue dip vats, the preparation of which I shall explain further on. I found that indigo was susceptible of forming insoluble compounds with the lime and protoxide of iron. White indigo dissolves freely in strong sulphuric acid, giving a dark purple blue liquor.

Many substances are employed commercially to convert blue indigo into the white indigo, soluble in alkalies. Thus, I may mention lime and protoxide of iron, caustic alkali and protoxide of tin, or sulphuret of tin or arsenic, and zinc and caustic alkali; also organic substances, such as grape sugar and bran, which enter easily into fermentation. The following formulæ shows the difference of composition of the two indigos:—

Indigotine. Hydrogen. White Indigo.

$$2(C_8H_5NO) + 2H = C_{16}H_{12}NO_2$$

I shall now have the pleasure of proceeding to describe some of the methods employed by chemists to determine the relative commercial value of samples of this expensive dye. The best qualities of indigo from Bengal, Java, and Guatemala are light, have a uniform texture, and a fine coppery hue, which is increased by friction. The following analysis, made by M. Chevreul, shows the composition of a fair sample of commercial indigo:—

Indigotine	45
Matters soluble in alcohol	30
Matters soluble in ether	12
Resin soluble in hydrochloric acid ..	6
Mineral matters	7
	100

Commercial indigos are often adulterated with mineral matters of various kinds. This fraud is easily detected by calcining a known weight of the sample, which ought not to leave a residue of more than 10 per cent. The most common adulteration, however, is the addition of starch. This can be detected by boiling some of the pulverised indigo with a weak solution of hydrochloric acid. The insoluble starch is thus converted into soluble dextrine, which yields a beautiful purple colour with iodine.

There are several processes employed to determine the amount of indigotine in commercial indigos. I shall here only give the outline of three. The first consists in dissolving 1 grm. of the dry pulverised indigo in 12 grms. of concentrated sulphuric acid, and heating the whole at a temperature not exceeding 120° F., when the indigo combines with the sulphuric acid, and becomes perfectly soluble in water. It is then diluted with water, so that the whole occupies one litre. The operation is repeated with 1 grm. of pure indigotine, which serves as a standard of comparison. A solution of bleaching-powder or bichromate of potash—the first proposed by M. Chevreul, the latter by Dr. Penny—is prepared of such a strength that 100 volumes of the solution will completely destroy the whole of the colour produced by the grm. of indigotine. Part of the same liquor is then applied to the solution of the commercial indigo, and the number of volumes required to destroy the colour represents the percentage of indigo. Thus, if 60 divisions are required, it is assumed that there is 60 per cent, if 70 divisions 70 per cent. This method of estimating the indigotine is not to be relied on, as it always gives a much higher percentage of colour-giving principle than exists in the indigo, owing to the hypochlorous acid of the bleaching-powder and the chromic acid of the bichromate not only decomposing the indigotine, but acting on several colouring matters which are included in the portion soluble in alcohol in M. Chevreul's analysis.

The second process gives better results; it is due to Professor Fritzsche, and consists in introducing one part of indigo, finely pulverised, and one part of grape sugar, into 48 or 50 parts of boiling alcohol, to which is added 2 parts of a concentrated solution of caustic soda. The whole is put into a bottle exactly large enough to hold it and left to cool. By exposing the colourless liquid to the atmosphere, the reduced indigo which is in solution absorbs oxygen, and the indigotine is precipitated under the form of beautiful prismatic crystals.

The third process, devised by myself, I have found to give satisfactory results. It consists in introducing into a flask 1 part of finely pulverised indigo, 2 parts of green copperas, and 200 parts of water containing 10 per cent of caustic soda. The whole is kept at the boil for a short time, and allowed to cool. The clear liquor is exposed in shallow vessels to the atmosphere, when the soluble indigo is oxidised, and precipitates as pure indigotine. The residue in the flask is submitted to the treatment three times. The whole of the indigotine thus obtained is collected on a filter, dried, and weighed.

A commercial process, founded on the above method, is carried on by Messrs. Haas and Co., who sell indigo so purified under the name of refined indigo. An inferior quality is also prepared by heating indigo, at a moderate temperature, with weak muriatic acid, which dissolves lime and other mineral matters, as well as any starch it may contain; it is slightly washed and boiled with weak caustic soda, to dissolve the chlorophyl and other resinous impurities.

(To be continued.)

LABORATORY NOTES.

NEW APPARATUS FOR GENERATING H_2S, CO_2, AND H.

NEW forms and new modifications of apparatus are constantly being proposed and described for the convenient generation of H_2S, CO_2, and H in laboratory work. Many of these are somewhat complicated and expensive, more or less difficult to fill, and liable to breakage; as, for instance, the much-used apparatus of Kipp. I think the following simple application of an old principle will be found worthy of trial. The apparatus is cheap and easily made by anybody in a very short time, is easy to move about and to fill, and possesses every advantage of

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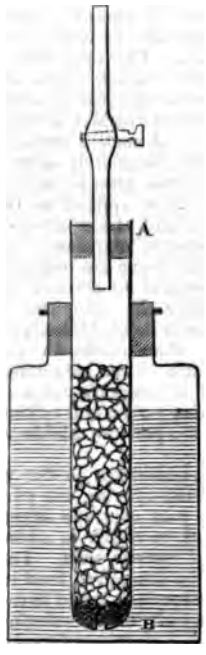
more complicated ones, as regards being always ready and easy of regulation.

A large wide-necked jar is provided with a well-fitting stopper of cork or caoutchouc. Owing to the difficulty of boring a large hole in caoutchouc, cork will generally be preferred. In this a hole is bored wide enough to take a piece of large-bore glass tube, A B. This tube is of such a length that it reaches almost to the bottom of the jar, and projects two or three inches above the stopper. One end of it, B, is held in the gas-blast, and turned round and round till it softens and partially runs together, leaving only a small opening. The other end is fitted with a caoutchouc stopper, through which passes a glass tube of suitable bore with a glass stopcock, all fitting perfectly tight. The tube reaches a little way below the stopper, and 3 or 4 inches above it, and is connected by india-rubber tube with wash-bottle, &c. The opening at B is covered with lead-shavings, a plug of lead wire, or pieces of glass, to allow the acid to rise into the tube, at the same time preventing any of the bits of marble, zinc, or sulphide of iron falling out. The tube, A B, being filled, is closed by its stopper and stop-cock tube, and inserted through the cork into the jar, which is a little over two-thirds full of the dilute acid. According as the stop-cock is opened, a stream of gas of any required amount is given off, and on closing the cock the acid is all driven into the jar. It is evident that the tube A B must not fit air-tight into the stopper of the jar. The best way of arranging is, after boring the hole in the cork for the tube A B, to cut a little channel with the triangular file, just sufficient to allow of the rise and fall of the liquid in the jar.



A jar about 10 inches high, and proportionately wide, with a tube of 1 to 1¼ inches bore, gives a very suitable apparatus for ordinary use. By using a very large jar, or a large cylinder, and larger and much longer tube, a constant stream may be had for many days.

W. M. Hutchings.

NOTICES OF BOOKS.

Experimental Chemistry, founded on the Work of Dr. Julius Adolph Stöckhardt. A Handbook for the Study of the Science by Simple Experiments. By C. W. Heaton, F.C.S., Professor of Chemistry in the Medical School of Charing Cross Hospital. London: Bell and Daldy. 1872.

There are two methods of studying chemistry, one by *reading* works on chemistry, but only one by which the student can become a chemist, by acquiring facts experimentally. Many handbooks are written merely as exponents of chemical theory, and leave experimental illustration to the care of the professor or teacher. But Mr. Heaton has adopted the true method of imparting a knowledge of chemistry by studying the science by simple experiments. These experiments, however, are not unassisted by theory in its proper place, that of a classification of facts from which laws may be deduced; and theoretical consideration is even extended to include the principles of correlate science with the most happy result. The success of Mr. Heaton's method of teaching is well known, and we cannot do better than refer students to his work. Organic and inorganic chemistry—both are dealt with, every experiment being illustrated with a woodcut showing the disposition of the apparatus employed. The various kinds of chemical formulæ also are admirably explained. Indeed, this may be said to be a perfect manual of elementary chemistry.

The Chemical History and Progress of Aniline Black. By John Lightfoot, Chemist. Published by the Author at Lower House, Burnley, Lancashire. 1871.

Mr. Lightfoot states the object of his pamphlet to be to give to chemists and others connected with dyeing and calico printing the history and progress of aniline black during the past ten years, as well as some curious experiments made with the purpose of determining many debated points of the processes of preparation. Mr. Lightfoot is the inventor and the first to introduce aniline black upon calico, so that the work has importance of the highest order. Inclusive mention is made of many important experiments with aniline black, including the results of the treatment of the prepared cloth with all the metals, scarce, noble, and common, a matter of enormous expenditure. There are many minor experiments of great interest, among which is the following:—An experimental normal colour was printed upon a piece of calico with a wood block, and whilst still wet a shilling and a sovereign, previously cleaned in nitric acid and water, were placed upon the cloth for fifteen minutes; the calico was aged twelve hours and washed, no trace being shown of the contact of the coins. The same coins were then placed in a bag with copper coins, and slightly shaken up with them. Applied then in the same way to the calico, and under the same conditions, the sovereign gave a dark slate, and the shilling an all but black colour. The mere rolling of a copper coin over the wetted calico is sufficient to induce the formation of the black.

We would wish to make a more lengthy extract, but in fairness to the author, who has been at such great expense with the experiments, we must refer to the pamphlet itself for results. To all who have much to do with calico printing the contents will be highly valuable.

CORRESPONDENCE.

WANKLYN AND CHAPMAN'S WATER ANALYSIS.

To the Editor of the Chemical News.

Sir,—Now that the "ammonia process" of Messrs. Wanklyn and Chapman is being generally accepted, it is proper that every phase of the question should be examined. May I therefore, through your columns, call the attention of the authors to two apparently conflicting statements in this little manual of "Water Analysis."

In the first edition, page 48, it is stated that, in distilling water, towards the end of the operation ammonia appears in the distillate, and that this latter portion must be rejected. Now, in estimating the free ammonia in water, it is recommended to distil only about 100 or 200 c.c., and then to add permanganate and proceed with the determination of the albumenoid, NH_3. What becomes of that portion of the ammonia which would be found in the receiver if the distillation had been carried nearly to dryness? Is this amount carried over with the albumenoid NH_3, or is this residual ammonia, as I may call it, merely the result of the decomposition of the nitrogenous matters in the water? Have the authors ever made any experiments to determine the amount of NH_3 which will pass over at the conclusion of the distilla-

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tion of ordinary water? I think it but right to call attention to this matter, as I believe that the ammonia method is destined to supersede all others, and that Messrs. Wanklyn and Chapman deserve the thanks of chemists for the ability and perseverance they have displayed. Hoping to gather from your readers some information upon the subject,—I am, &c.,

HENRY LEFFMAN, M.D.

417, Walnut Street, Philadelphia,
July 20, 1872.

ON THE PRESENCE OF ARSENIC IN COLOURED PAPERS.

To the Editor of the Chemical News.

SIR,—The danger arising from the use of arsenical colours in the manufacture of ornaments or toys cannot be over estimated.

The many illustrations given by Dr. Draper show how very common is the use of arsenical greens, on account of their superior brilliancy and stability when exposed to light.

I have found the poison also in a sample of "magenta" tissue paper, which had been used for Christmas decorations. The friend who brought it to me noticed the allianceous odour peculiar to arsenic when the paper was burnt. It was indeed so strong as to be unmistakable. I could easily detect arsenic by all the ordinary tests. Unfortunately, the sample was thrown aside without any quantitative estimation having been made. The paper must have been coloured with a very crude "magenta." I have not been able to extend the investigation to other articles of the same colour; but I think that the evil arising from the inhalation of minute quantities of arsenic being so great, its use in colours should be entirely prohibited.—I am, &c.,

G. J. WARNER.

Ardwick Bridge Chemical Works,
Manchester, July 29, 1872.

MISCELLANEOUS.

Chemical Appointments.—Dr. W. A. Tilden has been appointed Lecturer on Chemistry at Clifton College; and Mr. Frank Clowes, B.Sc. Lond., F.C.S., has been appointed Science Master at Queenwood College, Hants.

The British Association.—The Brighton meeting will commence on Wednesday, August 14, and continue till Thursday, August 22. On Thursday evening, the 15th, and on Tuesday evening, the 20th, *soirées* will be held. The entire northern block of the Pavilion property is allotted to these—namely, the Dome Assembly Room, the adjoining large building used in the days of the Regent as the Royal riding school, but now converted into a corn-exchange, and the recently-built free library and museum. The exhibition of pictures, articles of vertu, philosophical instruments, and objects of artistic and scientific interest will be very large and varied. The Brighton Natural History Society are arranging a complete flora of the south coast, both living and dried specimens; also a microscopical display, to which the most eminent London makers and the leading metropolitan societies will contribute. It is anticipated that about 400 microscopes will be in use during each *soirée*. On Friday evening, the 16th, and Monday evening, the 19th, lectures will be delivered by leading scientific men. An announcement has been made by the *Athenæum* that whatever information is received from Dr. Livingstone will be communicated at this Brighton meeting of the association. The Town-hall room, designated for the Geographical Section, will hold some 900 people; but it has been suggested that the Livingstone communications should be read in the Dome Assembly-room, which will seat from 2500 to 3000 persons. Four half-day excursions are arranged for Saturday, August 17, and five for Thursday, August 22. In connection with these several county noblemen and gentlemen will display liberal hospitality. The new Brighton Aquarium will be opened and stocked for the meeting of the association. Many invitations have been sent through the Mayor of Brighton, Mr. Cordy Burrows, to Continental and American *savans*, who will attend the meeting as the guests of the municipality. Numerous acceptances have already been received. Working men delegates are also invited from London and the chief centres of industry and manufactures, and a special lecture for working men will be delivered by Mr. W. Spottiswoode, F.R.S. As to the railway arrangements, return tickets will be issued by the Brighton Company to members of the association available from the 12th of August, or any following day, to return by any train and on any day to the 26th of August. Special fortnightly or monthly tickets, at reduced rates, will also be issued to members of the association, available to travel by any train between London and Brighton for the term. The railway company will also allow these fortnightly and monthly tickets to be issued to members of other scientific bodies in London on production of proof of membership. Applications for association tickets and local information should be addressed to the Rev. J. Beck, Secretary of the Local Executive Committee, at the Royal Pavilion, Brighton. The following are the officers elected:—President Elect—Dr. W. B. Carpenter, F.R.S. Vice-Presidents Elect—The Earl of Chichester; the Duke of Norfolk; the Duke of Richmond; the Duke of Devonshire, F.R.S.; Sir John Lubbock, Bart., M.P., F.R.S.; Dr. Sharpey, Sec. R.S.; Mr. Joseph Prestwich, F.R.S., Pres. G. S.—Section A. Mathematical and Physical Science. President—Warren De La Rue, F.R.S. Vice-Presidents—J. Norman Lockyer, F.R.S.; Lord Rosse, F.R.S.; Prof. H. J. Stephen Smith, F.R.S. Secretaries—Prof. W. K. Clifford; R. A. Proctor: A. C. Ranyard. Section B. Chemical Science. President—Dr. J. Hall Gladstone, F.R.S. Vice-Presidents—F. A. Abel, F.R.S.; Professor Williamson, F.R.S. Secretaries—Dr. Mills; W. Chandler Roberts; Dr. W. J. Russell, F.R.S.; T. Wood. Section C. Geology. President—R. A. C. Godwen-Austen, F.R.S. Vice-Presidents—Thomas Davidson, F.R.S.; Prof. P. M. Duncan, F.R.S.; Rev. T. Wiltshire. Secretaries—Henry Woodward; Louis C. Miall; G. Scott; William Topley. Section D. Biology. President—Sir John Lubbock, Bart., M.P., F.R.S. Vice-Presidents—John Ball, F.R.S.; Dr. Beddoe; Prof. Flower, F.R.S; Col. A. Lane Fox; J. Gwyn Jeffreys, F.R.S.; Dr. Burdon Sanderson, F.R.S. Department of Zoology and Botany. Sir John Lubbock, Bart., M.P., will preside. Secretaries—Prof. Thiselton Dyer; H. T. Stainton, F.R.S. Department of Anatomy and Physiology. Dr. Burdon Sanderson, F.R.S., will preside. Secretaries—Dr. Gamgee, F.R.S.; E. Ray Lankester; Dr. Rutherford; Dr. Pye Smith. Department of Anthropology. Col. A. Fox Lane will preside. Secretaries—Dr. Charnock; F. W. Rudler; J. H. Lamprey. Section E. Geography. President—Francis Galton, F.R.S. Vice-Presidents—Clements R. Markham; Major-General Sir Henry Rawlinson, Bart., F.R.S., Pres. R.G.S.; Major-General Strachey, F.R.S. Secretaries—H. W. Bates; A. Keith Johnston; Rev. J. Newton; J. H. Thomas. Section F. Economic Science and Statistics. President—Prof. Henry Fawcett, M.P. Vice-Presidents—R. Dudley Baxter; William Newmarch, F.R.S. Secretaries—J. G. Fitch; Edmund Macrory; Barclay Phillips. Section G. Mechanical Science. President—Frederick J. Bramwell, C.E. Vice-Presidents—John Hawkshaw, F.R.S.; C. W. Merrifield, F.R.S.; Charles B. Vignoles, F.R.S. Secretaries—H. Bauerman; J. Gamble.

Royal College of Science for Ireland.—The following is a copy of the examination paper used by Professor Galloway for the senior students in Practical Chemistry, on June 8th, 1872. *General Instructions.*—The same

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value is attached to each determination. Six hours are allowed for the analyses. *Assaying—For the Students in Mining.*—1. Determine the amount of copper in the sample of mine-water given you; each stroke of the pump delivers 33 gallons of this water, there are four strokes a minute, and the pumping is continued night and day. Calculate from your assay how much copper precipitate ought to be produced in twelve months, the copper precipitate containing 56 per cent of copper. 2. Determine by *wet* assay the amount of zinc in the sample of calamine given you, and give the quantity in 1 ton of the ore. 3. Determine by *dry* assay the quantity of lead in the sample of galena given you, and give the quantity in 1 ton of the ore. 4. Determine by *wet* assay the quantity of iron in the sample of hæmatite given you, and state the quantity in 100 parts. *Quantitative Analysis—For the Students in Manufactures.*—1. Estimate the amount of chlorine in the sample of chloride of lime given you, and calculate the quantity in French as well as in English degrees. 2. Determine the amount of free acid and water, and also the amount of chloride of sodium in the sample of salt-cake given you, and give the percentage results. 3. Determine the amount of nitrate of soda in the sample of crude soda-nitrate given you, and state the amount in 100 parts. 4. Determine the amount of copper in the sample of burnt pyrites given you, and state the amount in 20 tons of the burnt ore. *For the Students in Agriculture.*—The percentage amounts of the substances to be determined to be given in each case. 1. Determine the amount of non-volatile matter in the sample of guano given you. 2. Determine the amount of soluble phosphate in the sample of superphosphate given you. 3. Determine in the sample of crude sulphate of ammonia given you the quantity of sulphate of ammonia it contains. 4. Determine the amount of nitrate of soda in the sample of crude soda-nitrate given you.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, July 22, 1872.

This number contains the following original papers and memoirs relating to chemistry, &c.:—

Iron in the Blood of a Non-Vertebrated Animal.—Dr. Boussingault.—This essay contains the record of a series of experiments made by the author with the view of estimating the iron present in the blood of the common garden-snail. The blood, obtained by opening the heart (which, however, only yields one or two drops), is a slightly opalescent fluid, and is nearly colourless; it becomes, by exposure to air, a semi-gelatinous mass; viewed by the microscope, it is found to contain elliptical globules of about the same size as those seen in the blood of cows, and exhibits an alkaline reaction; it contains, in 100 parts—Water, 96·095, and dry substance, 3·905; while the ash amounts to 0·767, and the iron (as metal) to 0·00069. The flesh of the same snails contains, in 100 parts—Water, 84·88, and dry matter, 15·12; while the ash amounts to 3·0 per cent, and the iron (as metal) to 0·001176. 100 parts of the dried snail-blood contain—Iron, 0·0177; and 100 parts of the dried flesh contain—Iron, 0·0078. The blood of oxen contains about ten times more iron than their flesh, while the white blood of the snails contains only about twice the quantity of iron contained in their flesh.

New Process for the Estimation of Ozone.—P. Thenard.—The process is based upon the oxidation of arsenious acid by ozone. A slight excess of a titrated solution of arsenious acid (dissolved in hydrochloric acid) is poured into the bottle containing the ozone, the bottle is then well shaken, and the fluid titrated with permanganate of potassa. The author has purposely tried the effects of nitric, nitrous, and hyponitric acids, and he has found that these substances do not interfere with the correctness of the reaction alluded to, neither does peroxide of hydrogen (oxygenated water). As regards the actions of permanganate of potassa upon oxygenated water, the author states that Dr. Brodie's experiments on this subject hold good at the ordinary temperature of the air (then the permanganate is discoloured by the oxygenated water, the disposable oxygen of both being evolved), but the author finds that, when the mixture of the two substances alluded to is cooled by means of a freezing mixture, the oxygen of the permanganate, which becomes discoloured, is retained in the fluid, and remains combined with it as long as the low temperature is applied to the mixture.

New Process of Preserving Food Materials by means of Acetate of Soda.—Dr. Sacc.—This process consists in treating meat and vegetables either with a strong aqueous solution of, or with dry acetate of soda. The substances are left in contact with that salt from twenty-four to forty-eight hours, and then dried. Meat may be placed in a strong solution of the salt alluded to; the brine from the meat is to be evaporated, and is to be added to it when being cooked, in order to restore to it a portion of the salts and extractive matter taken up by the acetate of soda, the preservative action of which seems to depend upon the withdrawal of water from the alimentary substances.

Constitution of Acid Salts while in Solution.—Dr. Berthelot.—Notwithstanding the high scientific merits of this paper, which contains a series of formulæ, its contents are not suited for abstraction; an observation also applicable to the following essay:—

Theory of the Explosion of Detonating Materials.—P. Champion and H. Pellet.

Preparation of Ozone by means of a New Method of Producing an Electric Current.—A. Boillot.—By means of glass tubes coated with coke powder (rendered adhesive to the glass by means of gelatine), a current of galvanic electricity is caused to pass continuously, and without producing sparks, over oxygen, which is thus slowly converted into ozone.

This number contains several important memoirs relating to physiology, meteorology, acoustics, and geology.

July 29, 1872.

This number contains the following original papers and memoirs relating to chemistry:—

Quantity of Iron Contained in the Various Organic and Organised Constituents of the Blood.—Dr. Boussingault.—This memoir contains the detailed account of a series of experiments made with the view to ascertain the quantity of iron (as metal) contained in the various constituents of blood. 100 parts of fibrin contain 2·151 of mineral matter, and 0·0466 metallic iron. 100 parts of the blood-globules contain 1·325 mineral matter, and 0·350 iron. 100 parts of albumen contain 8·715 mineral matter, and 0·0863 iron. 100 parts of human blood contain 0·3 fibrin, 7·0 albumen, 12·7 globules, 1·0 mineral matter, and 79·0 water. 100 parts of cows' blood contain 0·4 fibrin, 7·4 albumen, 10·5 globules, 1·0 mineral matter, 80·7 water. The large quantity of iron met with in the blood-globules is due to the hematosine, which, when separated from defibrinated blood, is of a deep brown colour, insoluble in pure water, but soluble in water which has been rendered slightly alkaline. 100 parts of hematosine contain 10·750 of mineral matter, wherein are 6·33 metallic iron, equal to 9·043 peroxide of iron, leaving 1·707 other mineral matter. Further research exhibited the presence of lime and phosphoric acid in the ash of hematosine, which (the ash) was found to consist, in 100 parts, of 84·121 peroxide of iron, 13·512 phosphoric acid, and 2·986 lime. 100 parts of hematosine consist of 89·25 organic matter, 9·04 peroxide of iron, 1·45 phosphoric acid, and 0·32 lime.

Researches on the Carbon and Soluble Salts Contained in the Ovifak (Greenland) Meteorite.—Dr. Daubrée.—After referring to his former paper on this subject, the author gives an exhaustive account of his researches, more particularly relating to the proportions of free and combined carbon present in the meteorite referred to. The author distinguishes three different types in this mineral; the composition of each of these types is quoted as follows:—

	First Type.		Second Type.		Third Type.	
Metallic iron	40·94	71·09	80·8	82·4	61·99	70·1
Combined iron	30·15		1·6		8·11	
Combined carbon ..	3·00	4·064	2·6	2·9	3·60	4·7
Free carbon	1·64		0·3		1·10	
Silicium	0·75		0·291		Not estimated.	
Water	2·86		0·700		"	

Chlorides of iron and calcium, soluble in alcohol, were found in the second and third types percentically as follows:—

	Second Type.		Third Type.
	Non-malleable Part.	Malleable Part.	
Chloride of calcium ..	0·455	0·100	0·130
Chloride of iron	0·106	0·098	0·119

As regards the salts soluble in water, the following particulars are given for 100 parts in each type:—

	First Type.	Second Type.	Third Type.
Sulphate of lime	1·288	0·053	0·097
Chloride of calcium ..	0·039	0·233	0·126
Chloride of iron	0·027	0·089	0·114
	1·354	0·375	0·337

Constitution of Acid Salts when in Aqueous Solution.—Dr. Berthelot.—The continuation of a monograph on this subject.

Empyreumatic Hydrocarbons from Péchelbronn (Alsace).—J. A. Le Bel.—The main gist of this paper relates to the methods em-

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ployed for separating from each other two iodhydrates of amylen, one of which boils at 130°, and the other at 145°. This separation has been effected by means of hydrochloric acid at the ordinary temperature. In another portion of this memoir the author describes some experiments made with the view of converting hexylen into an iso-alcohol by means of sulphuric acid.

Industrial Preparation of Aniline Colours.—Ch. Girard and G. de Laire.—This paper mainly contains a refutation and correction of statements made and published by M. Lauth affecting the scientific labours of the authors, who affirm that they have not exaggerated the dangers arising from the use of arsenic acid in this branch of industry.

Study on the Gaseous Matter Evolved at Santorin (Italy) during the Volcanic Eruption of 1866.—M. Gorceix.—This memoir, elucidated by several tables exhibiting the results of experiments, is a valuable contribution to our knowledge on the subject of the gaseous matter evolved during volcanic eruptions.

Among the meteorological memoirs contained in this number, we call attention to the following :—

Fall of a Meteorite in the Commune de Lancé, Canton de Saint-Amand (Loir et Cher).—M. de Tastes.—This paper, illustrated by a map delineating the course of the meteorite, contains a detailed and well-authenticated account of the phenomena observed during the fall of this meteorite.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 236, August, 1872.

Report on the Phosphoric Acid and Phosphates Manufactory of Blanchard.—M. Barral.—This exhaustive memoir contains the account of the author's visit to the works alluded to, and already mentioned in the CHEMICAL NEWS, vol. xxvi., pp. 47 and 48. As an appendix to these works, M. Barral has, it appears from a brief note added to this report, established at Pantin (near Paris) a small factory for the purpose of extracting from sewage-water the ammonia it contains, by first adding to that water (heated by means of steam to a temperature of 30° to 35°) milk of lime, and next forcing a current of air through it by means of a blowing-van. The air, charged with ammonia, is made to pass through sulphuric acid, whereby sulphate of ammonia is produced. It appears that this method of eliminating the ammonia is very successful and rapid in action.

Bitumen and its Application to Public Works.—M. Homberg.—An important contribution to our knowledge on asphalte and its applications.

Contrivance for Freezing Water.—E. Carré.—The description, illustrated by a woodcut, of an ice-making machine.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, May 26, 1872.

Testing and Verification of Alcoholometers and Areometers.—M. Collardeau-Vacher.—The continuation and concluding portion of this essay, copiously elucidated by tables and algebraical formulæ.

Newly-Contrived Apparatus for Indicating the Presence of Marsh-Gas in Coal-Pits.—M. Turquan.—The description of a rather complicated apparatus intended for the protection of pitmen from the danger of explosions.

Lacto-Butyrometer.—M. Marchard.—The detailed description, illustrated by woodcuts, of an instrument intended for the purpose of testing the quality of milk and its richness in butter.

Method for Ascertaining the Heating of Portions of Machinery.—Dr. Mayer.—In order to test whether any bearings or parts of machinery become heated by friction, the author proposes to cover the parts with a thin layer of iodide of mercury, as this red-coloured salt becomes black when exposed to a temperature of about 70°.

Gazzetta Chimica Italiana, No. 5, 1872.

This number contains the following original papers and essays:—

Determination of the Molecular Weights of the Saline Substances.—Dr. E. Paterno.—This memoir contains a review of the relation existing between the electrolytical equivalents and the molecular weights of some saline bodies. The author deducts from the researches of Faraday, Matteucci, and Becquerel that the electrolytical equivalents of the salts frequently correspond to their molecular weights; and he further holds that Faraday's law bears upon the decomposition of an equal number of molecules by equally strong electric currents, and that this may be applied to the determination of the molecular weight of the salts, which then are to be formulated, as exhibited in the following instances :—$CuCl_2$ and $CuCl_3$; $HgCl_2$ and Hg_2Cl_2; $SnCl_4$ and $SnCl_2$. For the silver salts—Ag_2O; Ag_2Cl_2; Ag_2SO_4; $Ag_2(NO_3)_2$, $Ag_2NO_3.I$; &c.

Detection of Iodine in Urine in the State of Iodide of Potassium.—C. Gianetti.—This paper contains a critical review of Dr. Pellogio's published memoir "On the Best Means of Detecting Iodine in Urine."

Composition of Candle-Nuts and Kernels and Cake of Cocoa-Nuts.—Dr. G. Nallino.—The first portion of this essay treats on the chemical analysis of the so-called candle-nuts, the seed of the *Aleurites triloba*, Forst., a tree met with in some of the islands of the Pacific Ocean, as well as in the Moluques. The husks of these nuts contain, in 100 parts—Water, 3·71; organic matter, 89·90; mineral matter, 6·39. The kernels contain, in 100 parts—Water, 5·25; fatty matter (extracted by means of sulphide of carbon), 62·97; cellulose and other organic matter, 28·99; mineral matter, 2·79. The quantity of nitrogen amounts to 3·64 per cent. The ash consists, in 100 parts, of—Lime, 18·69; magnesia, 6·01; potassa, 11·33; anhydrous phosphoric acid, 29·33. The second part of this memoir treats on the cocoa-nut cake, used as fodder for cattle after the oil has been pressed from the seed (fruit of *Cocos nucifera*, imported into Europe for extracting the oil it contains, chiefly used for soap making). 100 parts of the air-dry cake contain—Proteine substances, 21·20; fatty matter, 8·60; cellulose, 7·70; water, 9·36. The centesimal composition of the ash of this cake (carbonic acid being deducted) is—Potassa, 40·57; soda, 2·30; lime, 4·71; magnesia, 2·95; peroxide of iron, 3·54; phosphoric acid, 26·98; sulphuric acid, 3·78; silica, 3·38; chlorine, 13·42. The centesimal composition of the kernels of the cocoa-nut in natural state is—Water, 5·80; fatty matter extracted by sulphide of carbon, 67·85; cellulose and other organic matter, 24·80; ash, 1·55.

Annalen der Chemie und Pharmacie, No. 9, 1872.

This number contains the following original papers and memoirs:—

New Derivative of Styphnic Acid.—Dr. J. Schreder.—In the introduction to this paper the author refers at some length to his former researches on the subject of styphnic acid, also known as oxypicric acid, and next treats at length on the action of cyanide of potassium upon the neutral potassa salt of the acid just mentioned. The result of this reaction (the process of preparation and purification of the crude product is described at great length) is the formation of a new body, which has been named resorcin-indophan, a substance soluble in water (the solution exhibiting a blue-violet colouration), insoluble in alcohol and ether, somewhat soluble in boiling-hot acetic acid, and readily so in concentrated sulphuric acid. The formula of this body is $C_6H_4N_4O_6$. The potassa, soda, and baryta salts of this substance are next described, and the essay winds up with a lengthy discussion on the constitutional formula of this body, this portion being elucidated by very lengthy and complex formulæ.

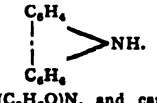
Some Combinations of Vinyl.—Dr. E. Baumann.—This exhaustive monograph is divided into the following sections:—Introduction, containing a condensed review of the labours of Sawitsch, Semenoff, Miasnikoff, and Dr. A. W. Hofmann on this subject; action of sodium methylate upon an excess of iodide and of bromide of vinyl at the ordinary temperature; experiments made with the view to ascertain the action of the cyanides of potassium and of silver upon bromide of vinyl; conversion of the bromide and chloride of vinyl into isomeric bodies.

Camphoric Acid.—F. Wreden.—This essay contains, in the first place, a detailed description of an improved method of preparing camphoric acid; next, a lengthy review of the results of the researches obtained by other scientific chemists who have studied camphoric acid, which is, according to the author, a bibasic acid of the formula $C_8H_{14}(CO_2H)_2$. There exist four isomeric modifications of camphoric acid—viz., dextro- and sinistro-camphoric acids (*i.e.*, optically active); para-camphoric acid, optically inactive; and meso-camphoric acid, discovered by the author, and obtained from the dextro-camphoric acid by the action of hydrochloric or hydriodic acids. The meso-camphoric acid is, in pure state, a solid substance in the form of needle-shaped crystals, is more soluble in water than the other camphoric acids, fuses at 113°, and readily soluble in alcohol and ether. The formula of this acid is $C_{10}H_{16}O_4$. This essay further treats on the substitution-products of camphoric acid anhydride and on amido-camphoric acid, on oxycamphoric acid anhydride (camphanic acid) and on some salts and derivatives from these bodies.

On Carbazol.—C. Graebe and C. Glaser.—Carbazol is a substance met with in crude anthracen, and has been also synthetically prepared by one of the authors by passing vapours of aniline and of diphenyl-amine through red-hot tubes. The preparation of carbazol from the crude material (viz., a heavy coal-tar oil) is described at very great length. In pure state, carbazol is a white-coloured, crystalline, solid substance, fusing at 238°, boiling at 351·5°, insoluble in water, but readily soluble in alcohol, ether, benzol, sulphide of carbon, glacial acetic acid, and chloroform. Carbazol is soluble, without decomposition, in concentrated sulphuric acid, yielding a somewhat yellowish brown-coloured solution, which turns to a deep green colour when the sulphuric acid contains the slightest trace of nitric acid, which strikes with carbazol a green colour. Carbazol forms sulpho- and nitro-compounds and a peculiar combination with picric acid—

$$C_{12}H_9N,C_6H_2(NO_2)_3OH.$$

The formula of carbazol is $C_{12}H_9N$; considered as imido-diphenyl the formula is—



Ethyl-carbazol, $C_{12}H_8(C_2H_5)N$, and carbazoline, $C_{12}H_{11}N$ (the product of the reaction ensuing when carbazol is heated along with phosphorus and hydriodic acid), are described at length, as is also hydrocarbazol, $C_{12}H_{12}N$.

Vapour Densities of Some Aromatic Compounds of High Boiling-Point.—C. Graebe.—This essay possesses high scientific merits, and it is elucidated by several tables exhibiting results of experiments. Its contents are not, however, suited for useful abstraction.

Les Mondes, August 1, 1872.

This number contains no original matter relating to chemistry or collateral subjects.

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Polytechnisches Journal von Dr. E. M. Dingler, first number for July, 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral subjects:—

New Form of Noë's Thermo-Electric Element.—A. von Waltenhofen.—The detailed description, illustrated by an engraving, of an improved thermo-electric element suited for therapeutical and other induction apparatus.

Contribution to the Technology of Glass.—E. Siegwart.—This exhaustive essay treats on the history of the discovery of glass, its modes of manufacture, and the present condition of the industry.

Preparation of Thallium on the Large Scale.—M. Schaffner.

Sulpho-Acids of Aniline Blue.—E. Bulk.—This essay treats on—Triphenyl-rosanilin-monosulpho acid (the soda-salt of which is known as Nicholson's blue, or alkali blue; the acid is monobasic); triphenyl-rosanilin-disulpho acid (the soda-salt of this acid is known in practice as soluble blue); triphenyl-rosanilin-trisulpho acid; triphenyl-rosanilin-tetrasulpho acid (the highest sulpho-compound obtainable from aniline blue by the action of sulphuric acid; it is soluble in water, with a blue colour; its alkaline and other salts are readily soluble in water, but insoluble in alcohol). Aniline violet also yields sulpho-acids, but not so readily as aniline blue.

Manufacture of Chili Saltpetre (Nitrate of Soda) and of Iodine at Tarapaca, Peru.—Dr. R. Wagner.—This essay contains statistical figures of the quantities of nitrate of soda obtained daily in eleven of the larger works, the production of which varies from 200 to 1200 cwts. The quantity of iodine met with in 1 litre of the mother-liquors of the works alluded to was found to vary from 2·30 to 4·80 grms.

Embalming Composition.—Dr. Bufaline.—For the purpose especially of preserving cadavers for anatomical use, the author recommends the following mixture:—Camphor and pure carbolic acid, each, 70 grms.; paraffin oil, 200 grms. This fluid is either applied by injection into the blood vessels, or the parts of the cadaver to be kept are soaked in it.

The American Journal of Science and Arts, July, 1872.

With the exception of two papers which we reserve for full reproduction, this number contains no original papers relating to chemistry.

Bulletin de l'Academie Imperiale des Sciences de St. Petersbourg, Vol. xvii., No. 4.

New Variety of Hexylen.—N. Tchaikowsky.—After briefly referring to the hexylens discovered and described by Drs. Erlenmeyer, Buff, and Wanklyn, the author states that, starting from methyl-diethyl-carbinol (obtained by causing chloride of acetyl to act upon zinc ethyl), he has converted that alcohol, first into its corresponding iodide, by means of gaseous iodhydric acid, and next this compound has been treated in a sealed tube at 100° with alcoholic caustic potassa solution. Hereby a liquid colourless hydrocarbon was obtained boiling at from 68° to 72°. The vapour density of this body, referred to air, is 2·908; referred to hydrogen, 42·900. The simplest formula is C_6H_{12}; but the constitutional formulæ, which, when combined with hydriodic acid, forms the tertiary iodide of methyl-diethyl-carbinol, are—

$$C{-}CH_2CH_3 \quad \text{or} \quad C{-}CH_2CH_3$$

The first of these formulæ is considered by the author as the most correct; but further research, and the behaviour of this new hexylen with hypochlorous acid will settle this point.

La Revue Scientifique de la France et de l'Etranger, July 20, 1872.

The Chemical Manures Judged by Tradition.—Dr. G. Ville.—The opening discourse of the experimental lectures on practical agriculture at Vincennes.

July 27, 1872.

This number contains no original papers relating to chemistry, but we call attention to the following physiological essay:—

Chemical Modifications which the Secretions Undergo under the Influence of Substances which Modify the Blood Globules.—Dr. Ritter.

Preis Courant der Fabrik für Alkohol-Präparate, von C. A. F. Kahlbaum, Berlin.

This catalogue of chemical preparations shows rapid advances of manufacturing chemistry in Germany, many rare and complex substances being quoted as regularly prepared. Under the section Methyl-Alcohol, for instance, we meet with methyl-cyanide, trimethylamins, methylen-iodide, and tetrachloride of carbon.

NOTES AND QUERIES.

Glacial Sulphuric Acid.—(Reply to S. R. P.)—This acid may be obtained from Dr. L. O. Marquart, Bonn, at 8 thalers per kilogramme net.

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THE CHEMICAL NEWS.

Vol. XXVI. No. 664.

BRITISH ASSOCIATION
FOR THE
ADVANCEMENT OF SCIENCE.

Brighton Meeting, August 14, 1872.

INAUGURAL ADDRESS OF THE PRESIDENT,

William B. Carpenter, M.D., LL.D., F.R.S.,
Registrar of the University of London.

My Lords, Ladies, and Gentlemen,—

Thirty-six years have now elapsed since at the first and (I regret to say) the only meeting of this Association held in Bristol,—which ancient city followed immediately upon our national universities in giving it a welcome,—I enjoyed the privilege which I hold it one of the most valuable functions of these annual assemblages to bestow; that of coming into personal relation with those distinguished men whose names are to every cultivator of science as "household words," and the light of whose brilliant example, and the warmth of whose cordial encouragement are the most precious influences by which his own aspirations can be fostered and directed. Under the Presidency of the Marquis of Lansdowne, with Conybeare and Prichard as Vice-Presidents, with Vernon Harcourt as General Secretary, and John Phillips as Assistant Secretary, were gathered together Whewell and Peacock, James Forbes and Sir W. Rowan Hamilton, Murchison and Sedgwick, Buckland and De la Beche, Henslow and Daubeny, Roget, Richardson, and Edward Forbes, with many others, perhaps not less distinguished, of whom my own recollection is less vivid.

In his honoured old age, Sedgwick still retains, in the academic home of his life, all his pristine interest in whatever bears on the advance of the science he has adorned as well as enriched; and Phillips still cultivates with all his old enthusiasm the congenial soil to which he has been transplanted. But the rest,—our fathers and elder brothers —"Where are they?" It is for us of the present generation to show that they live in our lives; to carry forward the work which they commenced; and to transmit the influence of their example to our own successors.

There is one of these great men, whose departure from among us since last we met claims a special notice, and whose life—full as it was of years and honours—we should have all desired to see prolonged for a few months, could its feebleness have been unattended with suffering. For we should all then have sympathised with Murchison, in the delight with which he would have received the intelligence of the safety of the friend in whose scientific labours and personal welfare he felt to the last the keenest interest. That this intelligence, which our own expedition for the relief of Livingstone would have obtained (we will hope) a few months later, should have been brought to us through the generosity of one, and the enterprising ability—may I not use our peculiarly English word, the "pluck"—of another of our American brethren, cannot but be a matter of national regret to us. But let us bury that regret in the common joy which both nations feel in the result; and while we give a cordial welcome to Mr. Stanley, let us glory in the prospect now opening, that England and America will co-operate in that noble object which—far more than the discovery of the sources of the Nile—our great traveller has set before himself as his true mission, the extinction of the slave trade.

At the last meeting of this Association, I had the pleasure of being able to announce that I had received from the First Lord of the Admiralty a favourable reply to a representation I had ventured to make to him as to the importance of prosecuting on a more extended scale the course of inquiry into the physical and biological conditions of the deep sea, on which, with my colleagues, Professor Wyville Thomson and Mr. J. Gwyn Jeffries, I had been engaged for the three preceding years. That for which I had asked was a circumnavigating Expedition of at least three years' duration, provided with an adequate scientific staff, and with the most complete equipment that our experience could devise. The Council of the Royal Society having been led by the encouraging tenor of the answer I had received, to make a formal application to this effect, the liberal arrangements of the Government have been carried out under the advice of a scientific committee which included representatives of this Association. H.M.S. *Challenger*, a vessel in every way suitable for the purpose, is now being fitted out at Sheerness; the command of the Expedition is entrusted to Captain Nares, an officer of whose high qualifications I have myself the fullest assurance; while the scientific charge of it will be taken by my excellent friend Professor Wyville Thomson, at whose suggestion it was that these investigations were originally commenced, and whose zeal for the efficient prosecution of them is shown by his relinquishment for a time of the important academic position he at present fills. It is anticipated that the Expedition will sail in November next; and I feel sure that the good wishes of all of you will go along with it.

The confident anticipation expressed by my predecessor that, for the utilisation of the total eclipse of the sun then impending, our Government would "exercise the same wise liberality as heretofore in the interests of science," has been amply fulfilled. An Eclipse Expedition to India was organised at the charge of the Home Government, and placed under the direction of Mr. Lockyer; the Indian Government contributed its quota to the work; and a most valuable body of results was obtained, of which, with those of the previous year, a report is now being prepared under the direction of the Council of the Astronomical Society.

It has been customary with successive occupants of this chair, distinguished as leaders in their several divisions of the noble army of science, to open the proceedings of the meetings over which they respectively presided with a discourse on some aspect of Nature in her relation to man. But I am not aware that any one of them has taken up the other side of the enquiry,—that which concerns man as the "interpreter of Nature;" and I have therefore thought it not inappropriate to lead you to the consideration of the mental processes by which are formed those fundamental conceptions of matter and force, of cause and effect, of law and order, which furnish the basis of all scientific reasoning, and constitute the *philosophia prima* of Bacon. There is a great deal of what I cannot but regard as fallacious and misleading philosophy—"oppositions of science falsely so-called"—abroad in the world at the present time. And I hope to satisfy you that those who set up *their own conceptions* of the orderly sequence which they discern in the phenomena of nature as fixed and determinate *laws*, by which those phenomena not only *are* within all human experience, but always *have been*, and always *must be*, invariably governed, are really guilty of the intellectual arrogance they condemn in the systems of the ancients, and place themselves in diametrical antagonism to those real philosophers, by whose comprehensive grasp and penetrating insight that order has been so far disclosed. For what love of the truth as it is in nature was ever more conspicuous than that which Kepler displayed, in his abandonment of each of the ingenious conceptions of the planetary system which his

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fertile imagination had successively devised, so soon as it proved to be inconsistent with the facts disclosed by observation? In that almost admiring description of the way in which his enemy Mars, "whom he hsd left at home a despised captive," had "burst all the chains of the equations, and broke forth from the prisons of the tables," who does not recognise the justice of Schiller's definition of the real philosopher as one who always loves truth better than his system? And when at last he had gained the full assurance of a success so complete that (as he says) he thought he must be dreaming, or that he had been reasoning in a circle, who does not feel the almost sublimity of the self-abnegation with which, after attaining what was in his own estimation such a glorious reward of his life of toil, disappointment, and self-sacrifice, he abstains from claiming the applause of his contemporaries, but leaves his fame to after ages in these noble words: "The book is written; to be read either now or by posterity, I care not which. It may well wait a century for a reader, as God has waited six thousand years for an observer."

And when a yet greater than Kepler was bringing to its final issue that grandest of all scientific conceptions, long pondered over by his almost superhuman intellect,—which linked together the heavens and the earth, the planets and the sun, the primaries and their satellites, and included even the vagrant comets, in the *nexus* of a universal attraction—establishing for all time the truth for whose utterance Galileo had been condemned, and giving to Kepler's laws a significance of which their author had never dreamed,—what was the meaning of that agitation which prevented the philosopher from completing his computation, and compelled him to hand it over to his friend? That it was not the thought of his own greatness, but the glimpse of the grand universal order thus revealed to his mental vision, which shook the serene and massive soul of Newton to its foundations, we have the proof in that beautiful comparison in which he likened himself to a child picking up shells on the shore of the vast ocean of truth—a comparison which will be evidence to all time at once of his true philosophy and his profound humility.

Though it is with the intellectual representation of nature which we call *Science*, that we are primarily concerned, it will not be without its use to cast a glance in the first instance at the other two principal characters under which man acts as her interpreter,—those, namely, of the artist and of the poet.

The artist serves as the interpreter of Nature, not when he works as the mere copyist, delineating that which he sees with his bodily eyes, and which we could see as well for ourselves; but when he endeavours to awaken within us the perception of those beauties and harmonies which his own trained sense has recognised, and thus impart to us the pleasure he has himself derived from their contemplation. As no two artists agree in the original constitution and acquired habits of their minds, all look at Nature with different (mental) eyes; so that to each, *Nature is what he individually sees in her.*

The poet, again, serves as the interpreter of Nature, not so much when by skilful word-painting (whether in prose or verse) he calls up before our mental vision the picture of some actual or ideal scene, however beautiful; as when, by rendering into appropriate forms those deeper impressions made by the nature around him on the moral and emotional part of his own nature, he transfers these impressions to the corresponding part of ours. For it is the attribute of the true poet to penetrate the secret of those mysterious influences which we all unknowingly experience; and having discovered this to himself, to bring others, by the power he thus wields, into the like sympathetic relation with Nature,—evoking with skilful touch the varied response of the soul's finest chords, heightening its joys, assuaging its griefs, and elevating its aspirations. Whilst, then, the artist aims to *picture* what he *sees* in Nature, it is the object of the poet to represent what he *feels* in Nature; and to each true poet, *Nature is what he individually finds in her.*

The philosopher's interpretation of Nature *seems* less individual than that of the artist or the poet, because it is based on facts which anyone may verify, and is elaborated by reasoning processes of which all admit the validity. He looks at the Universe as a vast book lying open before him, of which he has in the first place to learn the characters, then to master the language, and finally to apprehend the ideas which that language conveys. In that book there are many chapters, treating of different subjects; and as life is too short for any one man to grasp the whole, the scientific interpretation of this book comes to be the work of many intellects, differing not merely in the range but also in the character of their powers. But whilst there are "diversities of gifts," there is "the same spirit." While each takes his special direction, the general method of study is the same for all. And it is a testimony alike to the truth of that method and to the unity of Nature, that there is an ever-increasing tendency towards agreement among those who use it aright;—temporary differences of interpretation being removed, sometimes by a more complete mastery of her language, sometimes by a better apprehension of her ideas;—and lines of pursuit which had seemed entirely distinct, or even widely divergent, being found to lead at last to one common goal. And it is this agreement which gives rise to the general belief—in many, to the confident assurance—that the scientific interpretation of Nature represents her not merely as she *seems*, but as she *really is*.

When, however, we carefully examine the foundation of that assurance, we find reason to distrust its security; for it can be shown to be no less true of the scientific conception of nature, than it is of the artistic or the poetic, that it is *a representation framed by the mind itself* out of the materials supplied by the impressions which external objects make upon the senses; so that to each man of science, *nature is what he individually believes her to be*. And that belief will rest on very different bases, and will have very unequal values, in different departments of science. Thus in what are commonly known as the "exact" sciences, of which astronomy may be taken as the type, the data afforded by precise methods of observation can be made the basis of reasoning, in every step of which the mathematician feels the fullest assurance of certainty; and the final deduction is justified either by its conformity to known or ascertainable facts,—as when Kepler determined the elliptic orbit of Mars; or by the fulfilment of the predictions it has sanctioned,—as in the occurrence of an eclipse or an occultation at the precise moment specified many years previously; or, still more emphatically, by the actual discovery of the phenomena till then unrecognised,—as when the perturbations of the planets, shown by Newton to be the necessary results of their mutual attraction, were proved by observation to have a real existence; or as when then the unknown disturber of Uranus was found in the place assigned to him by the computations of Adams and Le Verrier.

We are accustomed, and I think most rightly, to speak of these achievements as triumphs of the human intellect. But the very phase implies that the work is done by mental agency; and the coincidence of its results with the facts of observation is far from proving the intellectual process to have been correct. For we learn from the honest confessions of Kepler, that he was led to the discovery of the elliptic orbit of Mars by a series of happy accidents, which turned his erroneous guesses into the right direction; and to that of the passage of the Radius Vector over *equal areas in equal times*, by the notion of a whirling force emanating from the sun, which we now regard as an entirely wrong conception of the cause of orbital revolution.* It should always be remembered, moreover, that the Ptolemaic system of astronomy, with all its cumbrous ideal mechanism of "Centric and Excentric, Cycle and

* See Drinkwater's "Life of Kepler," in the Library of Useful Knowledge, pp. 26 to 35.

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Epicycle, Orb in Orb," did intellectually represent all that the astronomer, prior to the invention of the telescope, could see from his actual standpoint, the earth, with an accuracy which was proved by the fulfilment of his anticipations. And in that last and most memorable prediction which has given an imperishable fame to our two illustrious contemporaries, the inadequacy of the basis afforded by actual observation of the perturbations of Uranus, required that it should be supplemented by an assumption of the probable distance of the disturbing planet beyond, which has been shown by subsequent observation to have been only an approximation to the truth.

Even in this most exact of sciences, therefore, we cannot proceed a step, without translating the actual phenomena of nature into intellectual representations of those phenomena; and it is because the Newtonian conception is not only the most simple, but is also, up to the extent of our present knowledge, *universal* in its conformity to the facts of observation, that we accept it as the only scheme of the universe yet promulgated which satisfies our intellectual requirements.

When, under the reign of the Ptolemaic System, any new inequality was discovered in the motion of a planet, a new wheel had to be added to the ideal mechanism,—as Ptolemy said, "to save appearances." If it should prove, a century hence, that the motion of Neptune himself is disturbed by some other attraction than that exerted by the interior planets, we should confidently expect that not an *ideal* but a *real* cause for that disturbance will be found in the existence of another planet beyond. But I trust that I have now made it evident to you, that this confident expectation is not justified by any absolute necessity of Nature, but arises entirely out of *our belief* in her uniformity; and into the grounds of this and other primary beliefs, which serve as the foundation of all scientific reasoning, we shall presently inquire.

There is another class of cases, in which an equal certainty is generally claimed for conclusions that seem to flow immediately from observed facts, though really evolved by intellectual processes; the apparent simplicity and directness of those processes either causing them to be entirely overlooked or veiling the assumptions on which they are based. Thus Mr. Lockyer speaks as confidently of the sun's chromosphere of incandescent hydrogen, and of the local outbursts which cause it to send forth projections tens of thousands of miles high, as if he had been able to capture a flask of this gas, and had generated water by causing it to unite with oxygen. Yet this confidence is entirely based on the assumption, that a certain line which is seen in the spectrum of a hydrogen flame, *means* hydrogen also when seen in the spectrum of the sun's chromosphere; and high as is the probability of that assumption, it cannot be regarded as a demonstrated certainty, since it is by no means inconceivable that the same line *might* be produced by *some other* substance at present unknown. And so when Dr. Huggins deduces from the different relative positions of certain lines in the spectra of different stars that these stars are moving from or towards us in space, his admirable train of reasoning is based on the assumption that these lines have *the same meaning*—that is, that they *represent the same elements*—in every luminary. That assumption, like the preceding, may be regarded as possessing a sufficiently high probability to justify the reasoning based upon it; more especially since, by the other researches of that excellent observer, the same chemical elements have been detected as vapours in those filmy cloudlets which seem to be stars in an early stage of consolidation. But when Frankland and Lockyer, seeing in the spectrum of the yellow solar prominences a certain bright line not identifiable with that of any known terrestrial flame, attribute this to a hypothetical new substance which they propose to call Helium, it is obvious that their assumption rests on a far less secure foundation; until it shall have received that verification, which, in the case of Mr. Crookes's researches on Thallium, was afforded by the actual discovery of the new metal, whose presence had been indicated to him by a line in the spectrum not attributable to any substance then known.

In a large number of other cases, moreover, our scientific interpretations are clearly matters of *judgment*; and this is eminently a *personal act*, the value of its results depending in each case upon the qualifications of the *individual* for arriving at a correct decision. The surest of such judgments are those dictated by what we term "common sense," as to matters on which there seems no room for difference of opinion, because every sane person comes to the same conclusion, although he may be able to give no other reason for it than that it appears to him "self-evident." Thus while philosophers have raised a thick cloud of dust in the discussion of the basis of our belief in the existence of a world external to ourselves,—of the Non Ego, as distinct from the Ego,—and while every logician claims to have found some flaw in the proof advanced by every other,—the common sense of mankind has arrived at a decision that is practically worth all the arguments of all the philosophers who have fought again and again over this battle-ground. And I think it can be shown that the trustworthiness of this common sense decision arises from its dependence, not on any one set of experiences, but upon *our unconscious co-ordination of the whole aggregate of our experiences*,—not on the conclusiveness of any one train of reasoning, but on *the convergence of all our lines of thought towards this one centre.*

Now this "common sense," disciplined and enlarged by appropriate culture, becomes one of our most valuable instruments of scientific inquiry; affording in many instances the best, and sometimes the only, basis for a rational conclusion. Let us take as a typical case, in which no special knowledge is required, what we are accustomed to call the "flint implements" of the Abbeville and Amiens gravel-beds. No logical proof can be adduced that the peculiar shapes of these flints were given to them by human hands; but does any unprejudiced person now doubt it? The evidence of *design*, to which, after an examination of one or two such specimens, we should only be justified in attaching a probable value, derives an irresistible cogency from accumulation. On the other hand, the *im*probability that these flints acquired their peculiar shape by *accident*, becomes to our minds greater and greater as more and more such specimens are found; until at last this hypothesis, although it cannot be directly disproved, is felt to be almost inconceivable, except by minds previously "possessed" by the "dominant idea" of the modern origin of man. And thus what was in the first instance a matter of discussion, has now become one of those "self-evident" propositions, which claim the unhesitating assent of all whose opinion on the subject is entitled to the least weight.

We proceed upwards, however, from such questions as the common sense of mankind generally is competent to decide, to those in which special knowledge is required to give value to the judgment; and thus the interpretation of Nature by the use of that faculty comes to be more and more *individual*; things being perfectly "self-evident" to men of special culture which ordinary men, or men whose training has lain in a different direction, do not apprehend as such. Of all departments of science, geology seems to me to be the one that most depends on this specially-trained "common sense;" which brings as it were into one focus the light afforded by a great variety of studies,—Physical and Chemical, Geographical and Biological; and throws it on the pages of that Great Stone Book, on which the past history of our globe is recorded. And whilst astronomy is of all sciences that which may be considered as most nearly representing Nature as she really is, geology is that which most completely represents her as seen through the medium of the interpreting mind; the meaning of the phenomena that constitute its data being in almost every instance open to question, and the judgments passed upon the

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same facts being often different according to the qualifications of the several judges. No one who has even a general acquaintance with the history of this department of science, can fail to see that the geology of each epoch has been the reflection of the minds by which its study was then directed; and that its true progress dates from the time when that "common sense" method of interpretation came to be *generally* adopted, which consists in seeking the explanation of past changes in the forces at present in operation, instead of invoking the aid of extraordinary and mysterious agencies, as the older geologists were wont to do, whenever they wanted—like the Ptolemaic astronomers—"to save appearances." The whole tendency of the ever-widening range of modern geological inquiry has been to show how little reliance can be placed upon the so-called "laws" of stratigraphical and palæontological succession, and how much allowance has to be made for local conditions. So that while the astronomer is constantly enabled to point to the fulfilment of his predictons as an evidence of the correctness of his method, the geologist is almost entirely destitute of any such means of verification. For the value of any prediction that he may hazard—as in regard to the existence or non-existence of coal in any given area,—depends not only upon the truth of the general doctrines of geology in regard to the succession of stratified deposits, but still more upon the detailed knowledge which he may have acquired of the distribution of those deposits in the particular locality. Hence no reasonably-judging man would discredit either the general doctrines or the methods of geology, because the prediction proves untrue in such a case as that now about to be brought in this neighbourhood to the trial of experience.

We have thus considered man's function as the scientific interpreter of Nature in two departments of natural knowledge; one of which affords an example of the strictest, and the other of the freest method, which man can employ in constructing his intellectual representation of the universe. And as it would be found that in the study of all other departments the same methods are used, either separately or in combination, we may pass at once to the other side of our inquiry,—namely the origin of those primary beliefs which constitute the groundwork of all scientific reasoning.

The whole fabric of geometry rests upon certain axioms which every one accepts as true, but of which it is necessary that the truth should be *assumed*, because they are incapable of demonstration. So, too, the deliverances of our "common sense" derive their trustworthiness from what we consider the "self-evidence" of the propositions affirmed.

This inquiry brings us face to face with one of the great philosophical problems of our day, which has been discussed by logicians and metaphysicians of the very highest ability as leaders of opposing schools, with the one result of showing how much can be said on each side. By the *Intuitionalists* it is asserted that the tendency to form these primary beliefs is inborn in man, an original part of his mental organisation; so that they grow up spontaneously in his mind as its faculties are gradually unfolded and developed, requiring no other experience for their genesis than that which suffices to call these faculties into exercise. But by the advocates of the doctrine which regards *experience* as the basis of all our knowledge, it is maintained that the primary beliefs of each individual are nothing else than generalisations which he forms of such experiences as he has either himself acquired or has consciously learned from others; and they deny that there is any original or intuitive tendency to the formation of such beliefs beyond that which consists in the power of retaining and generalising experiences.

I have not introduced this subject with any idea of placing before you even a summary of the ingenious *arguments by which* these opposing doctrines have been respectively supported; nor should I have touched on the question at all, if I did not believe that a means of reconcilement between them can be found in the idea, that *the intellectual intuitions of any one generation are the embodied experiences of the previous race.* For, as it appears to me, there has been a progressive improvement in the *thinking power* of man; every product of the culture which has preceded serving to prepare the soil for yet more abundant harvest in the future.

Now, as there can be no doubt of the hereditary transmission in man of acquired constitutional peculiarities, which manifest themselves alike in tendencies to bodily and to mental disease, so it seems equally certain that *acquired mental habitudes* often impress themselves on his organisation, with sufficient force and permanence to occasion their transmisson to the offspring as *tendencies to similar modes of thought.* And thus, while all admit that *knowledge* cannot thus descend from one generation to another, an increased *aptitude* for the acquirement, either of knowlede generally, or of some particular kind of it, may be thus inherited. These tendencies and aptitudes will acquire additional strength, expansion, and permanence in each new generation, from their habitual exercise upon the materials supplied by a continually enlarged experience; and thus the *acquired* habitudes produced by the intellectual culture of ages will become a "second nature" to every one who inherits them.*

We have an illustration of this progress in the fact of continual occurrence, that conceptions which prove inadmissible to the minds of one generation, in consequence either of their want of intellectual power to apprehend them, or of their preoccupation by older habits of thought, subsequently find a universal acceptance, and even come to be approved as "self-evident." Thus the first law of motion divined by the genius of Newton, though opposed by many philosophers of his time as contrary to all experience, is now accepted by common consent, not merely as a legitimate inference from experiment, but as the expression of a necessary and universal truth; and the same axiomatic value is extended to the still more general doctrine, that energy of *any* kind, whether manifested in the "molar" motion of masses, or consisting in the "molecular" motion of atoms, *must* continue under some form or other without abatement or decay; what all admit in regard to the indestructibility of matter, being accepted as no less true of force, namely, that as *ex nihilo nil fit*, so *nil fit ad nihilum.*†

But, it may be urged, the very conception of these and similar great truths is in itself a typical example of intuition. The men who divined and enunciated them stand out above their fellows, as possessed of a genius which could not only combine, but create, of an insight which could clearly discern what reason could but dimly shadow forth. Granting this freely, I think it may be shown that the intuitions of individual genius are but specially exalted forms of endowments which are the general property of the race at the time, and which have come to be so in virtue of its whole previous culture.

* I am glad to be able to append the following extract from a letter which Mr. John Mill, the great master of the experimental school, was good enough to write to me a few months since, with reference to the attempt I had made to place "common sense" upon this basis (*Contemporary Review*, Feb., 1872):—"When states of mind in no respect innate or instinctive have been frequently repeated, the mind acquires, as is proved by the power of habit, a greatly increased facility of passing into those states; and this increased facility must be owing to some change of a physical character in the organic action of the brain. There is also considerable evidence that such acquired facilities of passing into certain modes of cerebral action can in many cases be transmitted, more or less completely, by inheritance. The limits of this power of transmission, and the conditions on which it depends, are a subject now fairly before the scientific world; and we shall doubtless in time know much more about them than we do now. But so far as my imperfect knowledge of the subject qualifies me to have an opinion, I take much the same view of it that you do, at least in principle."

† This is the form in which the doctrine now known as that of the "conservation of energy" was enunciated by Dr. Mayer, in the very remarkable essay published by him in 1845, entitled "Die Organische Bewegung in ihrem Zusammenhange mit dem Stoffwechsel."

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Who, for example, could refuse to the marvellous aptitude for perceiving the relations of numbers, which displayed itself in the untutored boyhood of George Bidder and Zerah Colburn, the title of an intuitive gift? But who, on the other hand, can believe that a Bidder or a Colburn could suddenly arise in a race of savages who cannot count beyond five? Or, again, in the history of the very earliest years of Mozart, who can fail to recognise the dawn of that glorious genius, whose brilliant but brief career left its imperishable impress on the art it enriched? But who would be bold enough to affirm that an infant Mozart could be born amongst a tribe whose only musical instrument is a tom-tom, whose only song is a monotonous chant?

Again, by tracing the gradual *genesis* of some of those ideas which we now accept as "self-evident"—such, for example, as that of the "uniformity of nature"—we are able to recognise them as the expressions of certain intellectual tendencies, which have progressively augmented in force in successive generations, and now manifest themselves as mental instincts that penetrate and direct our ordinary course of thought. Such instincts constitute a precious heritage, which has been transmitted to us with ever increasing value through the long succession of preceding generations; and which it is for us to transmit to those who shall come after us, with all that further increase which our higher culture and wider range of knowledge can impart.

(To be continued.)

Section B.

ADDRESS
TO THE
CHEMICAL SECTION.

August 15, 1872.

By J. H. GLADSTONE, Ph.D., F.R.S.,
President of the Section.

Gentlemen,—

One of my fellow-students in the laboratory of the late Professor Graham began the study of chemistry because he wanted to be a geologist, and he had read in some geological catechism that, in order to be versed in that science, it was necessary, as a preliminary step, to gain a knowledge of chemistry, mineralogy, zoology, botany, and I know not what besides. My friend became a chemist, and found that enough for the exercise of his faculties. Yet the catechism had truth on its side; for so intertwined are the various branches of observational or experimental research, that a perfect understanding of one can only be obtained through an acquaintance with the whole cycle of knowledge.

Yet, on the other hand, who can survey the whole field even of modern chemistry? There was a time doubtless in the recollection of the more venerable of my auditors, when it was not impossible to learn all that chemists had to teach; but now that our "Hand-book" has grown so large that it would take a Briareus to carry it, and it requires a small army of abstractors to give the Chemical Society the substance of what is done abroad, we are compelled to become specialists in spite of ourselves. He who studies the general laws of chemistry may well turn in despair from the ever-growing myriads of transformations among the compounds of carbon; we have agricultural, physiological, and technical chemists; one man builds up new substances, another new formulæ; while some love the rarer metals, and others find their whole soul engrossed by the phenyl compounds.

How is this necessity of specialisation to be reconciled with the necessity of general knowledge? By our forming a home for ourselves in some particular region, and becoming intimately conversant with every feature of the locality and their choicest associations, while at the same time we learn the general map of the country, so as to know the relative position and importance of our favourite resort, and to be able—when we desire it—to make excursions elsewhere.

To facilitate this is one of the great objects of the British Association. The different Sections are like different countries, and leaving the insular seclusion of our special studies we can pass from one to the other, and gain the advantages of foreign travel.

From this Chair I must of course regard chemistry as the centre of the universe; and in speaking of other Sections I must think of them only in their relation to ourselves. There is that rich and ancient country, Section A, which, according to the Annual Report, comprises several provinces, Mathematics, Astronomy, Optics, Heat, Electricity, and Meteorology.

Mathematics and Astronomy.—It was when the idea of exact weights and measures was projected into it that alchemy was transmuted into chemistry: as our science has become more refined in its methods its numerical laws have become more and more significant, and it may safely be predicted that the more closely it is allied with general physics, the greater will be the mathematical knowledge demanded of its votary. But till lately the chemist and the astronomer seemed far asunder as the heavens and the earth, and none could have foretold that we should now be analysing the atmospheres of the sun and stars, or throwing light on the chemical composition of planetary nebulæ and the heads of comets. There is in this, too, as in other things, a reciprocal benefit; for we are encouraged to hope that this celestial chemistry will reveal to us elements which have not yet been detected among the constituents of our globe.

Light, Heat, and Electricity.—How intimately are these associated with the chemical force, or rather how easily are these Protean forces transformed into one another! The rays of the sun coming upon our earth are like a chemist entering his laboratory; they start strange decompositions and combinations not only in the vegetable kingdom, but also among inorganic gases and salts; they are absorbed selectively by different bodies which they penetrate, or are refracted, dispersed, and polarised according to the chemical composition and structure of the substance. All this has been the subject recently of much scientific research; and I need scarcely remind you of the beautiful art of photography as one of the results of photo-chemistry, or of the benefits that have arisen from a study of circular polarisation, indices of refraction, and especially spectrum analysis. In regard to the latter, however, I would remark that while the optical examination of the rays emitted by luminous vapours has yielded most brilliant results, there is another kind of spectrum analysis—that of the rays absorbed by various terrestrial gases, liquids, and solids—which has already borne valuable fruit, and which, as it is far more extensively applicable than the other, may perhaps play a still more important part in the chemistry of the future. The dispersion of the rays of the spectrum is certainly due to the chemical nature of the body through which they pass; but this is as yet almost unbroken ground waiting for an explorer. As to heat, it has ever been the tool of the chemist; and it would be difficult to overestimate the significance of researches into the specific heat, or the melting- and boiling-points of elements and their compounds. The laws of chemical combination have been elucidated lately by thermo-chemical researches; it has been sought to establish a connexion between the absorption or radiation of heat and the complexity of the chemical constitution of the active body; while the power of conducting heat, or of expanding under its influence, offers a promising field of inquiry. As to electrical science, one department of it—galvanism—is

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strictly chemical; the electrolytic cell does our work; and indeed we claim half the electric telegraph, for while the needle may oscillate in Section A, the battery belongs to B.

Last in Section A comes meteorology; and there are chemical questions concerning the constitution of the atmosphere, its changes, and the effect of its occasional constituents upon vegetable and animal life, which merit the deepest attention of the physiologist, philanthropist, and statesman.

If we turn to Section C, there is an outlying province belonging to us, namely, mineralogy, which lies on the frontiers of geology. A vast and very promising region is the origin and mode of formation of different minerals: this has attracted some explorers during the past year; but in order to investigate it properly the geologist and the chemist must travel hand in hand. Geology, in demanding of us the analysis of earths and ores, rocks and precious stones, repays us by bringing to our knowledge many a rare element and strange combination.

When we pass from C to D, that is from the crust of the globe to the organised beings that inhabit and adorn it, we are introduced into new regions of research. When organic chemistry was young, Cuvier said of it, "Dans cette nouvelle magie, le chimiste n'a presque qu'à vouloir: tout peut se changer en tout; tout peut l'extraire de tout;" and though we have now learnt much of the laws by which these magical transformations proceed, they far transcend the dreams of the French philospher; there is yet no visible limit to the multitude of products to be derived from the vegetable and animal world, and their changes seem to afford boundless scope for chemical ingenuity. The benefit here also is reciprocal; for the physiologist enters by our aid into the wonderful laboratory of the living plant or animal, and learns to estimate the mode of action of different foods and medicines. There have lately been some good researches of this character; the difficulties are great, but the results to be achieved are worthy of any effort.

There may be little intercourse between us and the geographers in E, but we stand in no distant relationship with many of the subjects discussed in F. Economic science embraces the chemical arts from cookery upwards; such imperial questions as that of the national standards, or the patent laws, interest us greatly; the yield of our corn-fields is increased through our knowledge of the constituents of soils and manures, and upon many of the chemical manufactures depend in no small degree the commerce and the wealth of Britain.

In this most important branch of technical chemistry we need the skill of the mechanician; and this introduces us to Section G. One of the questions of the day will illustrate the connexion between these varied departments of study. Statistics prove that the consumption of coal is now advancing, not at the gradual pace which recent calculations allowed, but at a rapidly accelerating speed, and they make the householder anxious about rising prices, and the political economist about the duration of our coal-fields. It is well known that there is a great waste of fuel throughout the country, as the maximum of heat produced by the combustion is very far from being ever utilised; and it will be for the combined wisdom of the chemist, physicist, and mechanician to devise means for reducing this lavish expenditure, or to indicate other available sources of power.

While this correlation of the natural sciences renders it desirable that the votary of one should have some general acquaintance with the rest, the correlation of all knowledge shows that no education can be complete which ignores the study of nature. A mind fed only on one particular kind of lore, however excellent that kind may be, must fail of proper nourishment. I am not going to say a word against philological studies: I am too fond of them myself for that; and I could wish that the modern languages were taught more, and the classic languages were taught better than they are at present. What I do contend for is, that chemistry (or some cognate branch of science) should have an honoured place in the education of every English lady and gentleman. I say purposely "an honoured place;" for at present where chemistry is introduced we too often find the idea latent which was expressed by one principal of a lady's college, who told a friend of mine that he was to give the girls a course of pretty experiments, but that she did not expect him to teach them anything; and we know that when boys repeat chemical experiments at home it is looked upon as an amusement, a philosophical one no doubt, but rather objectionable, inasmuch as they spoil their mother's towels, and singe their own eyebrows.

Of course some knowledge of chemistry is indispensable for a large number of our manufacturers, and for the medical profession, while it is extremely valuable to the farmer, the miner, and the engineer. It will also be readily granted that information about the air we breathe, the water we drink, the food we live upon, the fuel we burn, and the various common objects we handle, must be of service to every man. But we are met by the advocates of the old system of education with the remark that the value of school-teaching does not depend so much upon the information given as upon the mental training. This I admit: though it seems to me that if the same training can be secured by two studies, the one of which (like the making of Latin verses) gives no information at all, and the other (like chemical analysis) imparts some useful knowledge, we should prefer the latter. But I hold that as a means of educating the mental faculties, chemistry, faithfully taught, has in many respects the advantage over literary studies. There is superabundant scope for the exercise of the memory; the powers of observation are developed by it to a wonderful degree; the reasoning powers may be well disciplined on the philosophy of chemical change, or the application of the laws of Dalton, Mitscherlich, and Avogadro; while the imagination may be cultivated by the attempt to form a conception of the ultimate particles of matter, with their affinities and atomicities, as they act and react upon one another under the control of the physical forces. And I might speak of higher considerations than mere intellectual culture; for surely the works of the Allwise and Bountiful Creator are a more truthful and a purer subject of contemplation for the opening minds of youth, and more in accordance with Christian ideas, than are the crude notions of a past stage of civilisation, and the ignorant and gross fancies of a defunct paganism.

There is another requirement in education—the training of the mind to the discovery and recognition of truth. For this purpose philological studies have no fitness; mathematical studies, though peculiarly adapted for it, apply only to cases where demonstrative proof is possible; but the study of physical science is remarkably well fitted for teaching the proper methods of inquiry, and the strict relations between theory and fact. Now the historian, the politician, the mental philosopher, the theologian, or any one else who desires to influence the thoughts of his fellow men, should be in a position to distinguish between truth and error in his own department; and his mind may be well disciplined for this by a study which is less liable to be disturbed by human passions, predilections, or wishes, and where the conclusions are more readily brought to the test of observation or experiment.

Our Government insists on a certain standard of education for all who are allowed to teach in our elementary schools. In those schools which receive no state aid it is only public opinion which can insist that the teacher shall be duly qualified himself. Such bodies as the British Association form this public opinion, and will deserve well of their country if they demand that those masters and mistresses shall know something of the material universe in which they move, and be able to

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impart to every child such scientific knowledge as shall afford him an interesting subject for thought, give him useful information, and discipline his mental powers.

Among the many services rendered by the monthly reports of the progress of chemistry which the Chemical Society publishes, and the British Association helps to pay for, there is one which is rather salutary than pleasant. They bring prominently before our notice the fact that in the race of original research we are being distanced by foreign chemists. I refer, not to the quality of our work, about which opinions will probably differ, but to the quantity, which can be determined by very simple arithmetic. This is a matter of no small importance, not only for the honour of England, but still more for the advancement of science and the welfare of man. From the Physical Chair of this Association last year, a note of warning was uttered in the following words, after a reference to the sad fate of Newton's successors who allowed mathematical science almost to die out of the country:—"If the successors of Davy and Faraday pause to ponder even on *their* achievements, we shall soon be again in the same state of ignominious inferiority." The President of the Chemical Society also, in the last Anniversary Address, drew attention to the diminished activity of chemical discovery, and to the lamentable fewness of original papers communicated. He traces this chiefly to "the non-recognition of experimental research by our universities," and suggests that in granting of science-degrees every candidate should be required, as in Germany, to prove his ability for original investigation.

Concurring in this, I would remark that other causes have also been assigned, and other suggestions have been made. There is the small recognition of original research even by our learned societies—at least such recognition as will come home to the understanding of the general public. It is true the fellowship of the Royal Society is awarded mainly for original discoveries, and there are two or three medals to be disposed of annually; but these distinctions fall to the lot of the seniors in science, often men who are beyond the need of encouragement; and though they doubtless are serviceable as incentives, there is many a beginner in the honourable contest of discovery who is too modest even to hope for the blue ribbon of science. While the Victoria Cross is awarded to few, every soldier who has borne part in a victory expects his clasp; and so might every man who has won victories over the secrets of nature fairly look for some public recognition. It has been suggested, for instance, that the Royal Society, in addition to the F.R.S., might institute an Associateship, with the letters A.R.S., designed exclusively for those younger men who have shown zeal and ability in original research, but whose discoveries have not been sufficient to entitle them already to the Fellowship. It is suggested, too, that the Chemical Society might give some medal, or diploma, or some similar distinction, to those who contribute papers of sufficient merit.

But beyond this is the non-recognition of scientific research by society in general. We can scarcely expect the average enlightened Englishman to be anything but versed by a graphic formula, or a doubly sesquipedalian word containing two or three compound radicals; but he need not continue to talk of the four elements, or of acids being neutralised by sugar. But, indeed, the so-called educated classes in England are not only supremely ignorant of science, they have scarcely yet arrived at the first stage of improvement—the knowledge of their own ignorance. Then, again, there is the excessive preference of practical inventions over theoretical discoveries; or rather, perhaps, the inability to appreciate anything but practical results. Thus a new aniline compound is nothing to it will dye a pretty colour; if we speak of the theory of a new metal by the spectroscope, they simply ask—What is it useful for? and the rigorous determination of an atomic weight has for them no meaning nor interest nor beauty. The general appreciation of science must be of gradual growth; yet there are wealthy men who know its value, and who might well become the endowers of research. There are, indeed, at present funds available for the purpose—such as the Government Grant, and the surplus funds of this Association; but the money is given simply to cover actual outlay, and this, though very useful, scarcely meets the case of those young philosophers who have no balance at their bankers, and yet must live. Will not some of these wealthy men endow experimental scholarships, or professorships, in connection with our colleges, institutions, or learned societies? As an instance of the good that may be effected in this way, may be cited the Fullerian professorships; and as a very recent example, worthy of all honour, may be mentioned the purpose of Mr. J. B. Lawes, not only to continue his elaborate experiments at Rothamsted throughout his lifetime, but to place his laboratory and experimental fields in trust, together with £100,000, so that investigations may be continued in the wider and more scientific questions which the progress of agriculture may suggest.

The Government of our country, through the Science and Art Department, renders good assistance to the teaching of science, and if the recommendations of the Royal Commission on Scientific Instruction and the Advancement of Science be adopted, the introduction of practical examinations for the obtaining of certificates for a superior grade of science-master will certainly foster a spirit of research. It has been generally held that the promotion of research is within the legitimate scope of Government; and where, as in the case of Aristotle and Alexander, genius and industry have been sustained by princely munificence, the happiest results have ensued. Yet this question of Government aid is a delicate one: for genius, when put into swaddling clothes, is apt to be stifled by them; and were science to depend on political favour or imperial support, it would be a fatal calamity. Still I think it will be everywhere admitted that science might with propriety be subsidised from the public funds in cases where the results may be expected to confer a direct benefit upon the community, and where the inquiry, either from its expense, its tediousness, its uninteresting character, or the amount of co-operation required, is not likely to be carried out by voluntary effort. The astronomical work which is paid for by Government bears upon navigation, and answers both these requirements; and it is easy to conceive of inquiries in our own science that might equally deserve the assistance of the State. Some of these might also more than repay the outlay, though perhaps the profit would not fall into next year's budget.

I believe that this diminution of original research, which we deplore, is partly due to a cause in which we rejoice—the recent extension of science-teaching. The professorships of chemistry are scarcely more numerous now than they were twenty years ago, while the calls upon the professor's time in conducting classes, or looking over examination papers, have greatly augmented. Thus some of the most capable men have been drawn away from the investigation of nature; and in order to afford them sufficient leisure for the purpose, means must be found to multiply the number of the professorships in our various colleges.

While the rudiments of science are being infused into our primary education, now happily becoming national, while physical science is gradually gaining a footing in our secondary and our large public schools, and while it is winning for itself an honourable place at our universities, it is to be hoped that many new investigations will arise, and that British chemists will not fall behind in the upward march of discovery, but will continue hand in hand with their continental brethren thus to serve their own and future generations.

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THE ANALYSIS OF WATERS IN INDIA.*

By EDWARD NICHOLSON, F.C.S.,
Assistant Surgeon R.A., Analyst of Waters, Mysore, Northern and Ceded Districts.

(Concluded from p. 65).

PASSING now to the more important quantitative analysis, we find the processes indicated hardly more trustworthy than those already noticed. The first determination does not look promising:—

"*Total solids.*—Evaporate to dryness half a litre of the water (or a litre or more) . . . . The evaporation is preferably carried on from first to last in a platinum capsule, but the evaporation may be carried to a small bulk in a porcelain capsule, and the residue transferred by the aid of a wash bottle and a very flexible steel spatula, to the weighed platinum capsule in which the operation is to be completed."

I need hardly say that however flexible be the spatula, the operation thus sanctioned would be fatal to any pretensions of accuracy, and it seems rather superfluous to add, "Whichever plan is adopted, the capsule should be protected during the operation with a piece of filtering paper to keep out dust."

The next process is scarcely more commendable:—

"*Silica.*—Treat the ignited residue with dilute hydrochloric acid, taking care to avoid loss by effervescence, dilute with water, and if the silica is in any quantity, or if an exact analysis is required, collect it in a filter, wash, dry, ignite, and weigh."

In these directions the necessary ignition of the liberated and soluble silicic acid is omitted, so that whether the analyst collects such silicic acid as may perchance be visible, or whether he avails himself of the permission to neglect it, the chances of accuracy are not much affected. It will be remarked that the show of accuracy in the caution against loss by effervescence, or gain by fortuitous dust, is accompanied by neglect to mention the most necessary precautions, and by permission to pass over a substance like silicic acid, often amounting to a fourth or a third of the whole solid constituents of a water.†

These are, however, trifling sins compared to the following gross inaccuracy in the process given for the determination of alkaline chlorides:—

"Add some chloride of ammonium (to convert sulphate of sodium or potassium into the chloride), evaporate, ignite, and weigh the residual chloride of sodium and potassium. If the water contain only a small proportion of sulphuric acid, the addition of the chloride of ammonium will suffice for the conversion of the sulphates into chlorides; but if the proportion of sulphuric acid is large, it is necessary to add at once before the addition of the milk of lime a quantity of chloride of barium equivalent to the known amount of the sulphuric acid."

The author of the scheme here distinctly commits himself to the statement that ignition of sodium sulphate with ammonium chloride changes the former into sodium chloride. Little or much sulphuric acid can make no difference in the reaction. *This statement is without the slightest foundation in fact.* Sodium sulphate ignited even with a considerable excess of ammonium chloride shows no signs of change, the weight remains unaltered, and the solution of the residue gives no indication of chloride being present. The experiment is easy to perform, so that anyone can test for himself the accuracy of the statement I here challenge. The reactions of ammonium salts (sulphate, chloride, carbonate) on the mineral constituents of water are cardinal points in water analysis, and I have no hesitation in expressing my opinion that the above statement is in itself sufficient for the rejection of the scheme compiled by the Chemical Examiner to the Government of India.

In conclusion I beg to disclaim any cavillous spirit in thus drawing attention to the fallacies of the three schemes of water analysis which have succeeded one another during the last two years. Had I remained silent I should have failed in the duty I owe to my profession as a chemist. I have endeavoured, in as moderate a manner as possible, to expose errors which are unfortunately too often overlooked in the desire of the medical profession for a royal road to a science which nothing but long practical experience can teach. In the course of these papers I have fixed as much as possible on certain points where any objector could join issue with me, but I have met with no reply, save in a single instance—that of my experience with the albumenoid ammonia process for the estimation of organic matter.*

With this exception my criticisms of the authorised methods of analysis have met with no defence, and I think that it is now time for action to be taken on this question.

The necessity of a sound system for the chemical examination of waters is obvious; as long as the results obtained are erroneous,—as long as not only the quantity but the very presence of the substances found is uncertain in the highest degree—so long will sanitary science endeavour in vain to formulate the qualities distinctive of good and bad water. The laws by which the Bengal Chemical Examiner judges waters are given in the Sixth Report on the Analysis of Waters, they are entirely compiled from English theories, and would have condemned every water in Bengal, had not the wretched mode of examination prescribed defeated their rigorous provisions. They may be thus summarised.

(There are nine or ten defects possible in a water, anyone of which is strong evidence of sewage contamination, but the absence of any or all of them is no proof that the water has not at some previous time been polluted.)

When we find that these lynch laws and these peculiar rules of evidence are joined to a system of examination so defective that waters are condemned as foul for the most doubtful reasons, while it totally fails to elicit the facts on which judgment should be based, it is evidently high time for reform in that department of science which has so long passed for chemistry in India.

A few examples of the chemical evidence current in Bengal may here be quoted. The waters of the station of Hurripore are thus disposed of in the first report under my hand:—

"Lime is here very abundant in the waters, and goitre is said to be common. The water of the new well in the Fort is very inferior, quite unfit for drinking purposes, being loaded with the remains of excrementitious matter."

I turn to the columns of analyses and find that the only notable difference between the two well waters considered "fairly good," and that loaded with the remains of excrementitious matters (No. 3) is in the following particulars.

	1.	2.	3.
Oxygen required for 1000 grs. of water..	0·00198	0·00193	0·0044
Nitrous acid	Trace.	None.	Present.
Minerals solids grs. per gallon	17·95	20·80	24·50
Chloride of sodium ,, ,,	0·675	1·65	7·05

It is stated that neither of the three contained ammonia or nitric acid. (I pass over items of doubtful accuracy or importance.) The excess of oxygen required for No. 3 is no more than would be caused by 0·1 gr. of nitrous acid.

* Communicated by the Author.

† An Indian water containing 30 to 40 c.grms. per litre of solids *will often contain 10 to 12 c.grms. of silica.*

* On this point I was mistaken. My experiments failed with the apparatus supplied to me for working this new process, but I have since succeeded by the use of apparatus of my own construction. I was also misled to a great extent by the incomprehensible results of some of the examinations made by this method in India, and published. It will, however, be remembered that I gave the results of my experiments with some distrust, and with the announced intention of drawing forth the experience of other analysts on the value of this novel process. I do not regret this in any way, as I succeeded in bringing forward Mr. Harvey's experience; in consequence of which I tried again with proper apparatus, and with good results. Of the practical value of the process I am not yet satisfied; I am still examining that part of the question.

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and as the latter is present the evidence of the former drops. We thus find that the remains of excrementitious matters with which the water is said to be loaded, reduce themselves to 0·1 grain of nitrous acid, and a moderate amount of chloride of sodium; both of very natural occurrence in a new well, and affording *per se* not the slightest evidence of sewage contamination, past or present.

Another instance. We are told of Mean Meer that "the whole of the soil is thoroughly saturated with sewage matters; under these circumstances there is little hope of ever procuring drinkable water from any of the wells . . . there is abundant evidence to show that this typhoid fever is almost entirely due to the presence of sewage matters in water and air; . . . it is also believed that diarrhœa and cholera constantly result from the use of impure water;" and it is recommended that all the wells should be filled up. It certainly appears that the water is of unpleasant quality (though on the whole rather superior to that of the seven wells as supplied to the troops at Madras), but from the chemical evidence nothing can be brought in support of the charges of sewage contamination either of soil or of water. The following table gives a summary of the chemical examination of the twenty-six well waters.

	Extreme Quantities.	Average.
Oxygen required per million parts	0·25 to 1·6	—
Nitrous acid	None in 19, traces in 7	—
Nitric acid	Traces in 13, none or—in 13	—
Sulphuretted hydrogen	Traces in 24	—
Mineral solids, grains per gallon	33·4 to 86·2	50
Volatile solids, grains per gallon	0·45 to 2·94	1
Earthy salts	4·1 to 16·1	7
Chloride of sodium	1·4 to 5·5 (1 of 11·5)	3
Sulphate of soda	3·8 to 16·4	8
Carbonate of soda	12·7 to 59·2	40

These waters appear to be soft and very alkaline (a kind of Vichy water?); the sulphuretted hydrogen is almost certainly caused by decomposition of the alkaline sulphates; it will be remarked, however, that in several waters it is noted as existing along with nitrous acid, a very improbable occurrence, but either of these two substances would deoxidise the permanganate test, lessening considerably any importance that may be attached to the very moderate amount of oxygen said to be consumed by the water. The general absence of nitric acid, and the small amount of chloride of sodium, is strong evidence against sewage contamination. The principal ingredient appears to be carbonate of soda, perhaps the least objectionable saline substance it is possible to have in a water, and certainly not derived from sewage. I look in vain for any evidence in support of the charges; I can only find evidence tending directly to acquit both the soil and the water of the charges laid against them. There is not the slighest doubt that the well waters of ground generally contaminated by sewage show the traces of it most unmistakably, and therefore one, at least, of two things is certain, either that the charges made against the soil and waters of Mean Meer are devoid of foundation, or that the analyses, so called, are worthless. Here is a specimen of what has been done for sanitary science by four years of water analysis under the old system. Is there any guarantee that the new system of analysis will produce better results? No; the causes being the same, the effects will not change.

CORRESPONDENCE.

ESTIMATION OF MANGANESE.

To the Editor of the Chemical News.

SIR,—I have read the article on the "Estimation of Manganese," CHEMICAL NEWS, vol. xxvi., p. 37, contributed by Mr. Hugo Tamm. That gentlemen seems to have hit on a method of precipitating manganese which is possessed of some advantages, though I hardly think he is the originator of it; for, if I am not mistaken, Mr. Mattieu Williams employed the same reagent in the same manner when chemist at the Atlas Works some years ago. Be this as it may, the precipitation of manganese by ammonium carbonate is certainly complete, provided no free ammonia be present. I cannot say that I have found the precipitate to settle readily, some hours being required for tolerably complete subsidence. Mr. Tamm seems to be very imperfectly acquainted with the practice or literature of manganese estimations, for he apparently imagines the usual process employed to be the precipitation as sulphide, with re-solution and precipitation as carbonate. Upon such a method there can be no doubt the plan proposed is a great improvement, involving as it does but one precipitation instead of two. But has Mr. Tamm never heard of the bromine process, which not only precipitates the manganese in a form fit for weighing, but leaves—what is apparently Mr. Tamm's *bête noire*—the calcium in the filtrate?

It is commonly assumed that the bromine method is not applicable in presence of ammoniacal salts, but this is a mistake, for they seem to present little or no obstruction to its use. *Free* ammonia is, of course, decomposed by bromine, but the reaction occurs only very slowly in cold and dilute liquids, so that a solution of manganese, made slightly alkaline with ammonia in presence of ammonium salts, is readily and completely precipitated by bromine. As no fixed alkalies are employed, re-solution of the precipitate is quite superfluous.

Interesting as Mr. Hugo Tamm's contributions usually are, I trust he will excuse me if I suggest that they give the reader the impression that his knowledge of standard methods of analysis is derived from a single text-book, and that not a very recent one. Otherwise, it is difficult to understand how he could have been led to describe a process of estimating copper which is found in most works on analysis, the only novelty in his method being the use of ammonium in place of hydrogen sulphite, and ammonium sulphocyanide instead of potassium sulphocyanide. Mr. Tamm has also described a method of precipitating manganese as ammonio-phosphate, a process which originated with Dr. Wolcott Gibbs. But in these days, when analytical processes are published in many journals and several languages, it is next to impossible for those chemists who have not the advantage of a scientific library to keep up with the advance of analytical chemistry, especially in those branches of the subject in which they have no direct and daily interest. But does Mr. Tamm seriously imagine that any analyst worthy of the name is in the habit of separating iron from manganese by means of ammonia, except as a *rough* method of *qualitative* analysis? Mr. Tamm very rightly prefers to separate the iron with succinate of ammonium; but has he really tried this precipitant on the solution of 100 *grs.* of spiegeleisen, the quantity he recommends for the purpose? If not, let him accept my recommendation to try it, and, *when* he has filtered and thoroughly washed the iron precipitate, to communicate the result, and any remarks he may desire to make thereon. Every analyst has his pet methods, and those processes are the best to which he is most accustomed; but let me recommend Mr. Tamm to use ammonium acetate for the separation of iron and manganese, precipitating the latter metal from the filtrate by means of bromine, after concentration and addition of enough ammonia to render the liquid slightly alkaline. He can then precipitate any calcium or magnesium from the filtrate in the usual way.

No doubt the precipitation of manganese by ammonium carbonate may prove very useful occasionally, and Mr. Tamm has made a suggestion of considerable value in proposing it as a means of separating manganese from nickel and zinc.

In Sheffield the separation of iron and manganese is

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an everyday affair, and I have made many attempts to effect the estimation of manganese in spiegeleisen without first separating the iron. In this I have hitherto been unsuccessful, but am not without hope of ultimate success.—I am, &c.,

ALFRED H. ALLEN.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, August 5, 1872.

This number contains, in addition to several important papers on meteorology, astronomy, anatomy, and natural history, the following original memoirs relating to chemistry:—

Researches on Alcoholic Fermentation.—Prof. J. Dumas.—This exhaustive essay treats at great length on the much-discussed question of the real nature of fermentation. The eminent *savant* draws the following conclusions from his investigations:—No chemical movement excited in a saccharine liquor can convert sugar into alcohol and carbonic acid; the simple fermentation of a saccharine liquor and yeast may be regulated like any other chemical reaction; the duration of the fermentation is exactly proportionate to the quantity of sugar contained in the liquid; fermentation proceeds more slowly in the dark and *in vacuo*; no oxidation takes place during the fermentation; sulphur is converted into sulphuretted hydrogen by the fermentation; neutral gases do not modify the fermentation-inducing action of yeast; acids, bases, and salts can exercise an accelerating or retarding, disturbing or destructive, action on fermentation, but the accelerating action is more rarely observed; very dilute acids do not affect fermentation, but acids in larger quantity completely destroy it; the same applies to alkalies; carbonated alkalies only impede fermentation when they are present in, or added to, the fermenting liquid in large quantity; earthy carbonates do not interfere with fermentation; neutral salts of potassa and of some other bases exert no influence upon the process; silicate of potassa, borate of soda, soap, sulphites, hyposulphites, neutral tartrate of potassa, and acetate of potassa may be applied for the physiological analysis of ferment and for studying its mode of action.

Ferments Belonging to the Diastase Group.—Prof. J. Dumas.—This paper treats more particularly on the curious action of borax upon yeast, albumenoid substances, synaptase, diastase, myrosine, and malt extract, the salt completely neutralising the known effects of these substances.

Analysis of the Light Emitted by the Phosphorescent Compounds of Uranium.—E. Becquerel.—This exhaustive spectroscopical memoir is illustrated by woodcuts.

Improvement of Wines by Heating them.—Dr. Pasteur.—The contents of this memoir, to which is added a lengthy *procès-verbal* on the results of the investigation of a committee (consisting of wine-growers, wine-merchants, scientific men, and officials of the Ministry of Agriculture) on the subject of wines heated and not heated, chiefly interests wine-growing countries; we may, however, mention that the application of heat tends to improve wines.

Rapid Estimation of Phosphoric Acid, Magnesia, and Lime.—Dr. G. Ville.—Reserved for full translation.

Decolourising Effect of Concentrated Ozone.—A. Houzeau.—It appears that ozone greatly surpasses chlorine in its decolourising effects; this is shown by the action of these substances upon sulphate of indigo and other pigments; the destruction of the indigo is accompanied by the formation of oxygenated water (peroxide of hydrogen).

Some of the Derivatives of Tetrachloride of Naphthaline.—E. Grimaux.—The author describes the following compounds, the modes of preparation of which are recorded at length:—Bichlorated naphthyldrenic glycol—

$$C_{10}H_8Cl_2\left\{\begin{matrix}OH\\OH\end{matrix}\right.$$

a solid crystalline body, slightly soluble in cold water, soluble in about thirty times its weight of boiling water, and readily soluble in alcohol and ether; it fuses at 156°, and yields, with chloride of acetyl, a di-acetate—

$$C_{10}H_8Cl_2\left\{\begin{matrix}OC_2H_3O\\OC_2H_3O\end{matrix}\right.$$

a solid crystalline body. With chloride of benzoyl, a dibenzoate is formed—

$$C_{10}H_8Cl_2\left\{\begin{matrix}OC_7H_5O\\OC_7H_5O\end{matrix}\right.$$

a substance soluble in alcohol and ether, and fusing at from 148° to 150°. When bichlorated naphthyldrenic glycol is distilled with hydrochloric acid, there is formed monochlorated naphthol, $C_{10}H_6ClOH$, also a solid crystalline body, slightly soluble in cold, more so in boiling, water, and fusing at 109°; when this substance is dissolved in sulphuric acid, the addition of a crystal of oxalic acid produces a violet colour.

Annalen der Physik und Chemie, von Dr. J. C. Poggendorff, No. 6, 1872.

This number contains the following original papers and memoirs relating to chemistry:—

Manometrical Flames.—Dr. R. König.—This essay, illustrated by woodcuts, treats on acoustics.

Caloric Spectrum of the Sun and of Lime-Light.—S. Lamansky.—A lengthy spectroscopical memoir, illustrated by several engravings.

Experimental Researches on Fluorescens.—E. Hagenbach.—The continution of an exhaustive monograph on this subject.

Conducting Power of Iron and Argentan for Heat.—H. Weber.—An algebraico-physical essay.

Newly-Contrived Modification in the Construction of Holtz's Influence Machine (Influenz-Maschine) Constructed with Discs Rotating in Opposite Directions.—W. Museus.—Illustrated by engravings.

Identity of the so-called Immature Amber with Krantzite.—Dr. H. Spirgatis.—The krantzite investigated by the author was of the same consistency as the specimen of immature amber lately found in small quantity in the Baltic near the coast, and the krantzite behaves with solvents in the same manner. The specific gravity of the last-named mineral varies from 0·9822 to 0·9845, and its fusion-point was found by the author to be the same as that of the unripe amber, viz., 300°. The chemical composition of both the substances agrees very closely, and succinic acid is found in neither. According to Dana, krantzite is essentially succinite; it occurs in small grains and masses of a light yellow or greenish yellow colour; externally it has a reddish or brownish hue. The formula of krantzite is $C_{40}H_{64}O_4$.

Annales des Mines, No. 2, 1872.

This number contains no original papers relating to chemistry.

Bayerisches Industrie und Gewerbe-Blatt, July, 1872.

Detection of Fatty Oils in Ethereal Oils.—F. Rhica.—The process, described and illustrated by woodcuts, essentially consists of a careful process of distillation conducted with a small, but previously weighed or measured, quantity of the essential oil under investigation.

Preparation of Ferricyanide of Potassium.—F. Rhica.—To the cold saturated solution of ferrocyanide of potassium is added a sufficient quantity of rough hydrochloric acid to withdraw 1 atom of potassium from 2 atoms of the salt. There is next gradually added to this mixture a clear solution of hypochlorite of lime (bleaching-powder), until a small quantity of the fluid, tested with perchloride of iron does not indicate the presence of ferrocyanide of potassium; the fluid is then neutralised with chalk, and, lastly, evaporated to crystallisation. The advantages of this process are stated to be—(1) Conversion of the ferro- into ferri-cyanide at the ordinary temperature; (2) only one filtration, and no necessity of washing out a precipitate; (3) nearly the whole of the ferricyanide is obtained by crystallisation, while the last traces may be utilised by means of precipitation with sulphate of iron.

Preparation of Good Lutes and Cements.—Dr. Feichtinger.—This exhaustive memoir treats on—Oil cements; resin cements; glue and gum cements; casein cements; water-glass cements; lime gypsum, pipe-clay, and iron cements.

Annales de Chimie et de Physique, August, 1872.

This number contains the following original papers and essays:—

Researches on the State of Salts when in Solution.—Drs. Berthelot and L. de Saint-Martin.—This monograph is divided into the following sections:—Method and mode of operation; condition of acid salts when in solution; acid salts formed by acetic, benzoic, and polybasic acids; bisuccinates of potassa and ammonia. The general results of these researches may be summarised as follows:—The acid salts formed by monobasic acids do not exist in dilute solution; those formed by polybasic acids become partially decomposed; the quantity decomposed increases gradually, according to the increased dilution of the solution; this quantity continually varies, according to the *rapport* existing between the neutral salt and the excess of acid, and this variation takes place so that the stability of the acid salt is increased either by the presence of another neutral salt or by the presence of an excess of free acid; division of one base between two acids.

Thermic Researches on Sulphur.—Dr. Berthelot.—The contents of this essay may be summarised as follows:—The conversion of dissolved octahedrical sulphur into insoluble sulphur, under the influence of direct sunlight at the ordinary temperature of the air, is accompanied by an evolution of heat equal to about +12·8 cal. to the grm. The conversion of ordinary molten sulphur into insoluble sulphur, at 115°, is also accompanied by an evolution of caloric; this change does not take place by the simple fusion of pure octahedrical sulphur, but it occurs under the influence of sunlight.

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Oxysulphide of Carbon.—Dr. Berthelot.—Oxysulphide of carbon is gas prepared by the action of dilute sulphuric acid upon sulphocyanide of potassium; the formula of this gas is $C_2O_2S_2$. It yields with ammonia a compound, $C_2H_2NS_2O_2,NH_3$, carbamate of oxysulphide of ammonia, and, by the withdrawal therefrom of 2 equivalents of water, this substance yields sulphocyanide of ammonium, and, by the withdrawal of 2 equivalents of sulphuretted hydrogen, it yields urea, $C_2H_3NS_2,NH_3 - H_2S_2 = C_2H_4NO_2$.

Experimental Researches on the Duration of the Electric Spark.—F. Lucas and A. Cazin.—This essay, elucidated by engravings, is divided into the following sections:—Principle of the chronoscope lighted by electric sparks; description of apparatus; preliminary experiments; influence of the surface of the condenser; influence of the resistance of the conducting circuit; general formula for expressing the duration of the spark, as indicated by the functions of the three variable exponents, x, y, z.

Freezing of Water.—Prof. Boussingault.—After referring to the old experiments of the Fellows of the Academia dell Cimento at Florence, and also to the researches of Huyghens (1667), the author records the results of a series of experiments which fully prove that, if the resistance of the sides of the vessel (wherein water is exposed to great cold, the vessel being hermetically sealed) is greater than the expansive force of the act of congelation of the water, the latter remains liquid even at the lowest temperatures to which it is exposed.

Journal für Gasbeleuchtung und Wasserversorgung, No. 8, 1872.

This number contains the following original paper relating to chemistry:—

Influence of Coal-Gas upon Vegetation.—Dr. Virchow.—The author gives a detailed account of a series of experiments made, at the request of the municipal Government of Berlin, by himself and a committee of scientific men, for the purpose of elucidating the question whether the infiltration of coal-gas, in the soil whereupon plants and trees are grown, is or is not injurious to these. The result of the carefully-conducted researches is that coal-gas is an active poison to vegetation, and that trees, shrubs, and ornamental plants are killed by it.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, June 2, 1872.

Deviation of Smoke of Sea-Going Steamers.—Ch. Mène.—The author states that some officers of the Austrian navy have made experiments for causing the smoke arising from the fuel consumed in steam-ships to be discharged under water by the aid of a blowing machine; at the same time a more active and regular combustion is obtained, and the chances of fire on board greatly lessened, while the funnel or iron chimney, one of the most vulnerable parts above deck, is rendered unnecessary. The author has reason to believe that the experiments were in every respect successful.

Improved Safety-Tubes to be Applied instead of Woolf's Tubes.—Ch. Mène.—In a short paper, illustrated with woodcuts, a description is given of a neat contrivance, invented by Alvergnat, Frères, at Paris. The tubes are less liable to breakage and taking up less space than Woolf's.

Action of Sulphuric Acid on Wine.—Dr. L. de Martin.—The author has studied the effect of small quantities (from 1 to 3 grms. of concentrated acid to the hectolitre=22 gallons) of sulphuric acid upon the process of the fermentation of the must, the result being (1) more rapid and more complete fermentation; (2) a better and more beautiful colour of the wine; (3) analysis did not detect more sulphuric acid in this wine than in samples not so treated, while all the samples had been, as it is termed in Southern France, *plâtrés*, that is to say, treated (cleared) with gypsum. Dr. G. Chancel has repeated these experiments and more thoroughly investigated the process of the fermentation of must, and has found that when the must is alkaline, as it sometimes is, either from some unexplained cause inherent to the juice, or, or as is more usually the case, in consequence of much rain, the grapes are spattered and more or less covered with soil. The process of fermentation produces lactic acid instead of alcohol; hence the utility of the sulphuric acid for the purpose of setting up the alcoholic fermentation of the sugar. Dr. Chancel found no increase in the quantity of the sulphuric acid contained in wine so treated. Alcoholic fermentation is not possible in an alkaline fluid, the result in such a case being the formation of lactic acid, formed from the sugar.

American Journal of Pharmacy, August, 1872.

Monobromated Camphor.—Dr. J. M. Maisch.—After referring at some length to the researches of Th. Swart's, Laurent, Perkin, and others, the author describes at great length the results of his experiments made for the purpose of preparing monobromated camphor, which is now largely used medicinally in the United States. The process of preparation is divided into three distinct operations—(1) the combination of bromine with camphor, bibromide of camphor, which takes place at the ordinary or slightly elevated temperature, particularly in the presence of a trace of alcohol; (2) the formation of the substitution compound, monobromated camphor, which may be effected at a temperature of 100°, or in a much shorter time at 132°; (3) the utilisation of the oily residue, a by-product of the first action of bromine upon camphor, the greater part of which is converted into the substitution compound at 260°. Equivalent weights of camphor and bromine are used (the combining weight of camphor, $C_{20}H_{16}O_2$, is 152; that of 2Br=160), but in practice one-twelfth more of camphor is advisable. Monobromated camphor crystallises from alcohol in thin white or colourless prisms or needles; from petroleum-benzine it may be obtained in long flat prisms, which are perfectly transparent and hard. It is insoluble in water, readily soluble in alcohol, ether, and in less than its own weight of hot petroleum-benzine; it is permanent in the air, and not affected by direct sunlight; it fuses at about 67°, and boils, with partial decomposition, at 274°.

Some of the Constituents of the Rhizome of Sanguinaria Canadensis.—E. Peirpoint.—It appears that this drug contains puccin, sanguinarin, and sanguinaric acid; but the quantities of these substances obtained by the author at present are not large enough to admit of a full investigation of their properties and elementary composition, which will form the subject-matter of a future paper.

Disinfection of Sponges.—M. Leriche.—The sponges are first impregnated with a solution of 4 parts of permanganate of potassa in 100 parts of water, and next placed in a solution of 25 parts of sulphurous acid to 100 of water, and finally well washed with water. By this treatment sponges acquire their original condition, and even their marine odour, although they may have been soaked in pus and infectious matter.

Les Mondes, August 8, 1872.

In addition to several original papers and memoirs strictly relating to pharmacy, astronomy, meteorology, agriculture, and medicine, this number contains:—

Petites Annales de Chimie.—Dr. J. Maumené.—The continuation of a monograph on theoretical chemistry, elucidated by a series of algebraic and chemical formulæ.

On some Phenomena observed at Alatri (Italy), and the Effects of Lightning.—Rev. Father A. Secchi, S.J.—The eminent *savant* first gives an account of the difficulties encountered some eight years ago, when a lightning-rod was established on the cathedral and campanila of Alatri, buildings which, by their very isolated and elevated position, had often been injured by lightning. The greater portion of this essay is devoted to a minute description of the curious effects of a severe thunderstorm which took place on November 2nd, 1871, and which, while not materially injuring the building alluded to, shows that great care should be taken in the construction of lightning-rods of the proximity of iron gas- and water-mains (underground) comparatively near the spot where the claws of the lightning conductor are placed in the soil.

Bulletin de la Société Chimique de Paris, June 15, 1872.

This number contains the following original papers and memoirs:—

Researches on the Reciprocal Action between some Metals and Iodide of Acetyl.—H. Gal.—The author briefly refers to the researches of Wislicenus and Ponomaroff on this subject, and then states that while granulated zinc and small lumps of sodium are very strongly acted upon by iodide of acetyl, this does not take place when tin and mercury are brought into contact with that body; the result of the reaction being the formation of acetic acid, and a small quantity of a liquid heavier than water, and capable of combining with bromine.

Chlorobromide and Chloroiodide of Propylen.—C. Friedel and R. D. Silva.—This essay treats on the best modes of preparation of these bodies, and the reactions they exhibit. The contents of this paper are not, however, well suited for abstraction.

Action of Chloride of Iodine upon Chloroform, upon the Iodides of the Alcohol Radicals, and upon the Action of Bromine upon Chloroform.—C. Friedel and R. D. Silva.—The ultimate result of the action of chloride of iodine upon chloroform, which operation takes place in a sealed tube at from 160° to 170°, is the formation of tetrachloride of carbon, according to the formula $CCl_3H + 2ClI = CCl_4 + HCl + I_2$ It appears, however, that a small quantity of chloroiodide of carbon is also formed. Chloride of iodine acts strongly upon the alcohol radicals, converting these readily into chlorides, iodine being eliminated. By the action of bromine upon chloroform there is formed chlorobromide of carbon, CCl_3Br, a limpid fluid, sp. gr. at 0°=2·063.

Synthesis of Orcin, and on some Sulphurous Derivatives from Toluen.—G. Vogt and A. Henniger.—The contents of this essay have been already referred to, but the results of the authors' investigations are published *in extenso*.

Preparation of the Salts of Cæsium and Rubidium by means of Lepidolite.—Lecoq de Boisbaudran.—This mineral is acted upon by fluorhydric acid, and the cæsium and rubidium having been separated from the other constituents of the mineral (lepidolite) by well known methods, are isolated by making use of the difference of solubility of the bitartrates of these metals.

La Revue Scientifique de la France et de l'Etranger, August 3, 1872.

This number contains no original papers relating to chemistry, but we quote the titles of the following important memoirs:—

Development of Submarine Telegraphy.—E. Saigey.

Constitution and Movements of Glaciers.—Ch. Grad.

August 10, 1872.

This number contains no original papers relating to chemistry. We call attention to the following lecture:—

Vegetable Products.—Dr. G. Ville.—The continuation of the author's discourses on practical agriculture in the experimental field near Vincennes.

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PATENTS.

Communicated by Messrs. VAUGHAN and SON, Patent Agents, 54, Chancery Lane, London, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

1044. W. R. Lake, Southampton Buildings, London, "Improvements in the manufacture of pulp from vegetable fibres for making paper and other materials."—A communication from G. Swift, San Francisco, California, U.S.A.—Petition recorded April 8, 1872.

2261. W. E. Gill, Salisbury Street, Strand, W.C., "Improvements in treating vegetable juices, and in the apparatus and materials to be employed therefor."

2262. T. R. Crampton, Great George Street, Westminster, "Improvements in the manufacture of gas and fuel, and in apparatus to be used for this purpose."

2265. A. M. Clark, Chancery Lane, "Improvements in the manufacture of phosphoric acid and acid phosphate of lime, and the applications of the same."—A communication from L. H. Blanchard, Paris.—Petition recorded July 27, 1872.

2277. E. P. H. Vaughan, F.C.S., Chancery Lane, "Improvements in the treatment of phosphates of lime."—A communication from A. Striedter, Paris.

2279. J. Brown, Edinburgh, "Improvements in the treatment of sewage and in the manufacturing of manures."

2282. G. Haseltine, Southampton Buildings, London, "An improved process of converting cast-iron into steel."—A communication from T. H. Alexander, Washington, U.S.A.—Petitions recorded July 30, 1872.

2287. P. A. Dormoy and F. A. Paget, Adelphi, W.C., "Improvements in puddling furnaces."—Petition recorded July 31, 1872.

NOTICES TO PROCEED.

865. J. Werner, Mannheim, Baden, "An improved composition to be used as a substitute for 'brewers' pitch' for lining vats, casks, and tubs, and for other like purposes."—Petition recorded March 21, 1872.

908. G. J. Snelus, Dowlais, Glamorganshire, "An improved lining for cupola furnaces, also applicable to the formation of the beds of reverberatory furnaces."—Petition recorded March 25, 1872.

943. A. Beveridge, Leith, N.B., "Improvements in preparing, cleansing, and refining animal fats, and in the means and apparatus employed therefor."—A communication from A. Jurgens, Oss, North Brabant, Holland.—Petition recorded March 30, 1872.

971. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in liqueurs or cordials and other beverages, and in apparatus to be employed in their manufacture."—A communication from F. A. Joannon, Paris.

979. W. R. Lake, Southampton Buildings, London, "An improved compound for cleansing carpets and other woven fabrics."—A communication from L. Stern, Boston, Mass., U.S.A.—Petitions recorded April 9, 1872.

1051. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the treatment of animal and vegetable substances."—A communication from W. Adamson, Philadelphia, Penn., U.S.A.—Petition recorded April 9, 1872.

1376. D. G. Fitzgerald, Brixton, Surrey, and B. C. Molloy, of Elm Court, Temple, Middlesex, "Improvements in heating compound substances by the agency of electricity, and thereby decomposing them or resolving them into their components, and in apparatus employed therein."—Petition recorded May 6, 1872.

2006. G. Noble, Woodford Bridge, Essex, "Improvements in the method of treating various kinds of fibrous materials for the manufacture of writing, printing, and other paper."—Petition recorded July 3, 1872.

2156. F. J. Cheesbrough, Liverpool, "Improvements in evaporating and concentrating sulphuric and other acids, also salt, sulphur, and other substances capable of evaporation, and in the apparatus to be used therein."—A communication from W. T. Clough, Newark, Essex, New Jersey, U.S.A.—Petition recorded July 18, 1872.

2186. G. Thom, Chorley, Lancashire, and J. Stenhouse, Pentonville, London, "Improvements in treating fatty substances containing colouring matters, and in obtaining useful products therefrom."—Petition recorded July 22, 1872.

2263. G. T. Bousfield, Sutton, Surrey, "Improvements in furnaces for deoxidising iron ores preparatory to their being worked into wrought-iron."—A communication from J. Wilson, Dover, New Jersey, U.S.A.—Petition recorded July 29, 1872.

PATENTS SEALED.

425. R. F. Smith, Glasgow, N.B., "Improvements in obtaining yellow and red prussiates."

429. W. Ireland, Macclesfield, Cheshire, and J. Ireland, Manchester, "Improvements in the manufacture of cast or Bessemer steel ingots."—A communication from R. Pink, Hoerde, Westphalia.—Dated February 10, 1872.

454. F. H. Warlich, Camberwell, Surrey, "Improvements in the manufacture of artificial fuel, and in apparatus to be used for this purpose."—Dated February 13, 1872.

606. S. T. Vanel, Paris, "A new composition and process for waterproofing all sorts of tissues, linen, paper, and other materials."—Dated February 26, 1872.

752. E. Watteeu, Middlesboro'-on-Tees, Yorkshire, "Improvements in explosive compounds."—A communication from A. de Terré, and E. de Mercader, Liége, Belgium.—Dated March 12, 1872.

1080. J. J. Bodmer, Hammersmith, Middlesex, "Improvements in the manufacture of iron and steel."—Dated April 11, 1872.

1409. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the treatment of ores, more particularly iron ore, for the manufacture of cast-iron, wrought-iron, and steel therefrom, and in the apparatus to be employed therein."—A communication from La Société Metallurgique pour l'Exploitation des Procédés Ponsard, Paris.—Dated May 8, 1872.

1799. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the manufacture of iron."—A communication from W. Sellers, Philadelphia, Penn., U.S.A.

1801. G. Haseltine, Southampton Buildings, London, "Improvements in the manufacture of iron and steel, and in apparatus employed therefor."—A communication from J. W. Middleton, Philadelphia, Penn., U.S.A.—Dated June 14, 1872.

1837. T. Hampton, Ickles, near Rotherham, Yorkshire, "Improvements in the manufacture of Bessemer steel ingots."—Dated June 18, 1872.

NOTES AND QUERIES.

Pure Aluminum.—Can your readers inform me of an easy way by which I could procure pure aluminum in the laboratory as an experiment?—E. PURDON.

Lamp for Water Oven.—Can any of your readers inform me of the best sort of lamp to use for a water-oven? I cannot get gas, and spirit of wine is too expensive, as I sometimes keep it going all night, and common oil makes a black mess with the soot that forms.—ALBION.

Powerful Galvanic Battery.—In Mr. Highton's description of a Powerful Galvanic Battery, I do not understand the instructions with respect to the arrangement for the "negative." Should feel obliged if Mr. Highton, or some of your readers, would give a little further explanation on the subject.—H. HARGREAVES.

Powerful Galvanic Battery.—Would Mr. Highton kindly give practical working directions for the construction of the battery described by him, and add information on the following points:—(1) Resistance compared with Grove or Bunsen; (2) comparative tendency to polarisation; (3) constancy and duration of action?—R. T. C.

Hydrocyanate of Morphia, &c.—(1). What is the best plan for making a true hydrocyanate of morphia? I have reason to fear that the hydrocyanate of morphia of Dr. J. M. Maisch (CHEMICAL NEWS, vol. xxiii., p. 310) is nothing but pure morphia. (2). Does the hydrocyanate of bismuth exist; if so, how is it obtained? (3). What is the best method to preserve meat by means of carbolic acid instead of common salt?—J. H. L. SCHUMANN, Murraysburg, Colony of the Cape of Good Hope.

Test for Pure Anthracen.—Can you or any of your readers give a simple and reliable test for the quantity of pure anthracen in a commercial sample of crude? I find those at present in use, viz., alcohol, methylated spirit, and bisulphide of carbon, all, the latter especially, dissolve a considerable portion of the anthracen, thereby causing the result to be very unsatisfactory. Now that this article has some commercial importance, an easily applied test, and one that would be free from doubt, is of considerable importance to tar distillers.—D. G.

Detection of Turmeric in Mustard.—In an article on the "Detection of Adulteration" in the "English Mechanic" of the 9th inst., Mr. A. H. Allen describes the following improved modification of the boracic acid test for turmeric:—"Shake half a teaspoonful of the mustard in the cold with two or three times its bulk of methylated spirits. Filter the solution, and evaporate the liquid to dryness at a steam heat in a porcelain basin, in which is placed a piece of filter-paper about the size of a penny. When all the alcohol has been driven off, moisten the paper with a strong aqueous solution of boracic acid, and again evaporate completely. In presence of turmeric the paper will acquire a reddish colour; but, as a further proof, drop on it some solution of caustic potash or soda, which will produce a very beautiful series of colours, in which green and purple are most evident. On then adding hydrochloric acid, a red colour will be produced, which can be again turned green and blue by addition of excess of alkali. The colours are very vivid and characteristic, pure mustard giving no such result. . . . . Gamboge may be detected in the same way as turmeric, but gives a bright red instead of a green or blue colour on treatment with caustic soda, and on adding excess of hydrochloric acid the paper becomes merely yellow instead of the orange-red colour produced in presence of turmeric."

TO CORRESPONDENTS.

J. Cox.—Received, with thanks.

W. F. D.—You will find the original description in *Comptes Rendus*, January 15, 1872, and *Journal de Pharmacie et de Chimie*, March, 1872.

Mediocrity.—(1). Cannot say. (2). No. (3). Enquire at the British Museum. (4). Very little. (5). Cannot say.

NOTICE TO AMERICAN SUBSCRIBERS.

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THE CHEMICAL NEWS.

Vol. XXVI. No. 665.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Brighton Meeting, August 14, 1872.

INAUGURAL ADDRESS OF THE PRESIDENT,

William B. Carpenter, M.D., LL.D., F.R.S.,
Registrar of the University of London.

(Concluded from p. 77).

And now, having studied the working action of the human intellect in the scientific interpretation of Nature, we shall examine the general character of its products; and the first of these with which we shall deal is our conception of *matter* and of its relation to *force*.

The psychologist of the present day views matter entirely through the light of his own consciousness: his idea of matter in the abstract being that it is a "something" which has a permanent power of exciting sensations; his idea of any "property" of matter being the mental representation of some kind of sensory impression he has received from it; and his idea of any particular kind of matter being the representation of the whole aggregate of the sense-perceptions which its presence has called up in his mind. Thus, when I press my hand against this table, I recognise its unyieldingness through the conjoint medium of my sense of touch, my muscular sense, and my mental sense of effort, to which it will be convenient to give the general designation of the tactile sense; and I attribute to that table a *hardness* which resists the effort I make to press my hand into its substance, whilst I also recognise the fact that the force I have employed is not sufficient to move its mass. But I press my hand against a lump of dough; and finding that its substance yields under my pressure, I call it *soft*. Or again, I press my hand against this desk; and I find that, although I do not thereby change its *form*, I change its *place*; and so I get the tactile idea of *motion*. Again, by the impressions received through the same sensorial apparatus, when I lift this book in my hand, I am led to attach to it the notion of *weight*, or ponderosity; and by lifting different solids of about the same size, I am enabled, by the different degrees of exertion I find myself obliged to make in order to sustain them, to distinguish some of them as *light*, and others as *heavy*. Through the medium of another set of sense-perceptions, which some regard as belonging to a different category, we distinguish between bodies that *feel* "hot" and those that *feel* "cold;" and and in this manner we arrive at the notion of differences of temperature. And it is through the medium of our tactile sense, without any aid from vision, that we first gain the idea of *solid form*, or the three dimensions of space.

Again, by the extension of our tactile experiences, we acquire the notion of *liquids*, as forms of matter yielding readily to pressure, but possessing a sensible weight which may equal that of solids: and of *air*, whose resisting power is much slighter, and whose weight is so small that it can only be made sensible by artificial means. Thus, then, we arrive at the notions of *resistance* and of *weight* as properties common to all forms of matter; and now that we have got rid of that idea of light and heat, electricity and magnetism, as "imponderable fluids," which used to vex our souls in our scientific childhood, and of which the popular term "electric fluid" is a "survival," we accept these properties as affording the practical distinction between the "material" and the "immaterial."

Turning, now, to that other great portal of sensation, the sight, through which we receive most of the messages sent to us from the universe around, we recognise the same truth. Thus it is agreed alike by physicists and physiologists, that *colour* does not exist *as such* in the object itself, which has merely the power of reflecting or transmitting a certain number of millions of undulations in a second; and these only produce that affection of our consciousness which we call colour, when they fall upon the retina of the living percipient. And if there be that defect, either in the retina or in the apparatus behind it, which we call "colour-blindness" or Daltonism, some particular hues cannot be distinguished, or there may even be no power of distinguishing any colour whatever. If we were all like Dalton, we should see no difference, except in form, between ripe cherries hanging on a tree, and the green leaves around them; if we were all affected with the severest form of colour-blindness, the fair face of Nature would be seen by us as in the chiaroscuro of an engraving of one of Turner's landscapes, not as in the glowing hues of the wondrous picture itself. And in regard to our visual conceptions, it may be stated with perfect certainty, as the result of very numerous observations made upon persons who have acquired sight for the first time, that these do *not* serve for the recognition even of those objects with which the individual had become most familiar through the touch, until the two sets of sense-perceptions have been co-ordinated by experience.*

When once this co-ordination has been effected, however, the composite perception of form which we derive from the visual sense alone is so complete, that we seldom require to fall back upon the touch for any further information respecting that quality of the object. So, again, while it is from the co-ordination of the two dissimilar pictures formed by any solid or projecting object upon our two retinæ, that (as Sir Charles Wheatstone's admirable investigations have shown) we ordinarily derive through the sight alone a correct notion of its *solid* form, there is adequate evidence that this notion, also, is a mental *judgment* based on the experience we have acquired in early infancy by the consentaneous exercise of the visual and tactile senses.

Take, again, the case of those wonderful instruments by which our visual range is extended almost into the infinity of space, or into the infinity of minuteness. It is the mental, not the bodily eye, that takes cognisance of what the telescope and the microscope reveal to us. For we should have no well-grounded confidence in their revelations as to the *unknown*, if we had not first acquired experience in distinguishing the true from the false by applying them to *known* objects; and every interpretation of what we see through their instrumentality is a *mental judgment* as to the probable form, size, and movement of bodies removed by either their distance or their minuteness from being cognosced by our sense of touch.

The case is still stronger in regard to that last addition to our scientific *armamentum*, which promises to be not inferior in value either to the telescope or the microscope; for it may be truly said of the spectroscope, that it has not merely extended the range of our vision, but has almost given us a new sense, by enabling us to recognise distinctive properties in the chemical elements which were previously quite unknown. And who shall now say that we know all that is to be known as to any form of matter; or that the science of the *fourth* quarter of this century

* Thus, in a recently recorded case in which sight was imparted by operation to a young woman who had been blind from birth, but who had nevertheless learned to work well with her needle, when the pair of scissors she had been accustomed to use was placed before her, though she described their shape, colour, and glistening metallic character, she was utterly unable to recognise them *as scissors* until she put her finger on them, when she at once named them, laughing at her own stupidity (as she called it) in not having made them out before.

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may not furnish us with as great an enlargement of our knowledge of its properties, and of our power of recognising them, as that of its *third* has done?

But, it may be said, is not this view of the material universe open to the imputation that it is "evolved out of the depths of our own consciousness"—a projection of our own intellect into what surrounds us—an *ideal* rather than a *real* world? If all we know of matter be an "intellectual conception," how are we to distinguish this from such as we form in our dreams?—for these, as our laureate no less happily than philosophically expresses it, are "true while they last." Here our "common sense" comes to the rescue. We "awake, and behold it was a dream." Every healthy mind is conscious of the difference between his waking and his dreaming experiences; or, if he is now and then puzzled to answer the question "Did this really happen, or did I dream it?" the perplexity arises from the consciousness that it *might* have happened. And every healthy mind, finding its own experiences of its waking state, not only self-consistent, but consistent with the experiences of others, accepts them as the basis of his beliefs, in preference to even the most vivid recollections of his dreams.

The lunatic pauper who regards himself as a king, the asylum in which he is confined as a palace of regal splendour, and his keepers as obsequious attendants, is so "possessed" by the conception framed by his disordered intellect, that he *does* project it out of himself into his surroundings; his refusal to admit the corrective teaching of common sense being the very essence of his malady. And there are not a few persons abroad in the world who equally resist the teachings of educated common sense whenever they run counter to their own preconceptions; and who may be regarded as—in so far—affected with what I once heard Mr. Carlyle pithily characterise as "diluted insanity."

It has been asserted, over and over again, of late years, by a class of men who claim to be the only true interpreters of Nature, that we know nothing but matter and the laws of matter, and that force is a mere fiction of the imagination. May it not be affirmed, on the other hand, that while our notion of *matter* is a conception of the intellect, *force* is that of which we have the *most* direct—perhaps even the *only* direct—cognisance? As I have already shown you, the knowledge of resistance and of weight which we gain through our tactile sense is derived from our own perception of *exertion*; and in vision, as in hearing, it is the force with which the undulations strike the sensitive surface, that affects our consciousness with sights or sounds. True it is that in our visual and auditory sensations, we do not, as in our tactile, *directly* cognosce the force which produces them; but the physicist has no difficulty in making sensible to us indirectly the undulations by which sound is propagated, and in proving to our intellect that the force concerned in the transmission of light is really enormous.*

It seems strange that those who make the loudest appeal to experience as the basis of all knowledge should thus disregard the most constant, the most fundamental, the most direct of all experiences; as to which the common sense of mankind affords a guiding light much clearer than any that can be seen through the dust of philosophical discussion. For, as Sir John Hershel most truly remarked, the universal consciousness of mankind is as much in accord in regard to the existence of a real and intimate connection between cause and effect, as it is in regard to the existence of an external world; and that consciousness arises to every one out of his own sense of *personal* exertion in the origination of changes by his individual agency.

Now, while fully accepting the logical definition of cause as the "antecedent or concurrence of antecedents on which the effect is invariably and unconditionally consequent," we can always single out one *dynamical* antecedent—the power which does the work—from the aggregate of *material conditions* under which that power may be distributed and applied. No doubt the term cause is very loosely employed in popular phraseology; often (as Mr. Mill has shown) to designate the occurrence that immediately preceded the effect;—as when it is said that the spark which falls into a barrel of gunpowder is the cause of its explosion, or that the slipping of a man's foot off the rung of a ladder is the cause of his fall. But even a very slightly trained intelligence can distinguish the power which acts in each case, from the conditions under which it acts. The force which produces the explosion is locked up (as it were) in the powder; and ignition merely liberates it, by bringing about new chemical combinations. The fall of the man from the ladder is due to the gravity which was equally pulling him down while he rested on it; and the loss of support, either by the slipping of his foot, or by the breaking of the rung, is merely that change in the material conditions which gives the power a new action.

Many of you have doubtless viewed with admiring interest that truly wonderful work of human design, the Walter printing machine. You first examine it at rest; presently comes a man who simply pulls a handle towards him; and the whole inert mechanism becomes instinct with life, the blank paper continuously rolling off the cylinder at one end, being delivered at the other, without any intermediate human agency, as large sheets of print, at the rate of 15,000 in an hour. Now what is the *cause* of this most marvellous effect? Surely it lies essentially in the power or force which the pulling of the handle brought to bear on the machine from some extraneous source of power,—which we in this instance know to be a steam-engine on the other side of the wall. This force it is which, distributed through the various parts of the mechanism, really performs the action of which each is the instrument; *they* only supply the vehicle for its transmission and application. The man comes again, pushes the handle in the opposite direction, detaches the machine from the steam-engine, and the whole comes to a stand; and so it remains, like an inanimate corpse, until recalled to activity by the renewal of its moving power.

But, say the reasoners who deny that force is anything else than a fiction of the imagination, the revolving shaft of the steam-engine is "matter in motion;" and when the connection is established between that shaft and the one that drives the machine, the *motion* is communicated from the former to the latter, and thence distributed to the several parts of the mechanism. This account of the operation is just what an observer might give who had looked on with entire ignorance of everything but what his *eyes* could *see*; the moment he puts his *hand* upon any part of the machinery, and tries to stop its motion, he takes as direct cognisance, through his sense of the effort required to resist it, of the *force* which produces that motion, as he does through his *eye* of the motion itself.

Now, since it is universally admitted that our notion of the external world would be not only incomplete, but erroneous, if our visual perceptions were not supplemented by our tactile, so, as it seems to me, our interpretation of the phenomena of the universe must be very inadequate, if we do not mentally co-ordinate the idea of force with that of motion, and recognise it as the "efficient cause" of those phenomena,—the "material conditions" constituting (to use the old scholastic term) only "their formal cause." And I lay the greater stress on this point, because the mechanical philosophy of the present day tends more and more to express itself in terms of *motion* rather than in terms of *force*;—to become *kinetics* instead of *dynamics*.

Thus, from whatever side we look at this question,—whether the common sense of mankind, the logical analysis of the relation between cause and effect, or the study of the working of our own intellects in the interpretation of Nature,—we seem led to the same conclusion; that the notion of *force* is one of those elementary forms of thought with which we can no more dispense than we can with

* *See Sir John Herschel's "Familiar Letters on Scientific Subjects."*

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the notion of space or of succession. And I shall now, in the last place, endeavour to show you that it is the substitution of the dynamical for the mere phenomenal idea, which gives their highest value to our conceptions of that order of Nature which is worshipped as itself a god by the class of interpreters whose doctrine I call in question.

The most illustrative, as well as the most illustrious, example of the difference between the mere generalisation of phenomena and the dynamical conception that applies to them, is furnished by the contrast between the so-called laws of planetary motion discovered by the persevering ingenuity of Kepler, and the interpretation of that motion given us by the profound insight of Newton. Kepler's three laws were nothing more than comprehensive statements of certain groups of phenomena determined by observation. The *first*, that of the revolution of the planets in elliptical orbits, was based on the study of the observed places of Mars alone; it might or might not be true of the other planets; for so far as Kepler knew, there was no reason why the orbits of some of them may not be the excentric circles which he had first supposed that of Mars to be. So Kepler's *second* law of the passage of the Radius Vector over equal areas in equal times, so long as it was simply a generalisation of facts in the case of that one planet, carried with it no *reason* for its applicability to other cases, except that which it might derive from his erroneous conception of a whirling force. And his *third* law was in like manner simply an expression of a certain harmonic relation which he had discovered between the times and the distances of the planets, having no more *rational* value than any other of his numerous hypotheses.

Now the Newtonian "laws" are often spoken of as if they were merely *higher generalisations* in which Kepler's are included; to me they seem to possess an altogether different character. For starting with the conception of two *forces*, one of them tending to produce continuous uniform motion in a straight line, the other tending to produce a uniformly accelerated motion towards a fixed point, Newton's wonderful mastery of geometrical reasoning enabled him to show that, if these *dynamical* assumptions be granted, Kepler's *phenomenal* "laws," being necessary consequences of them, must be *universally* true. And while that demonstration would have been alone sufficient to give him an imperishable renown, it was his still greater glory to divine that the fall of the moon towards the earth—that is, the deflection of her path from a tangential line to an ellipse—*is a phenomenon of the same order* as the fall of a stone to the ground; and thus to show the applicability to the entire universe, of those simple dynamical conceptions which constitute the basis of the Geometry of the Principia.

Thus, then, whilst no "law" which is simply *a generalisation of phenomena* can be considered as having any *coercive* action, we may assign that value to laws which express *the universal conditions of the action of a force*, the existence of which we learn from the testimony of our own consciousness. The assurance we feel that the attraction of gravitation *must* act under all circumstances according to its one simple law, is of a very different order from that which we have in regard (for example) to the laws of chemical attraction, which are as yet only generalisations of phenomena. And yet even in that strong assurance, we are required by examination of the basis on which it rests, to admit a *reserve* of the *possibility* of something different; a reserve which we may well believe that Newton himself must have entertained.

A most valuable lesson as to the allowance we ought always to make for the unknown "possibilities of nature," is taught us by an exceptional phenomenon so familiar that it does not attract the notice it has a right to claim. Next to the law of the universal attraction of masses of matter, there is none that has a wider range than that of the *expansion of bodies by heat*. Excluding water and one or two other substances, the fact of such expansion might be said to be *invariable*; and, as regards bodies whose gaseous condition is known, the law of expansion can be stated in a form no less simple and definite than the law of gravitation. Supposing those exceptions, then, to be unknown, the law would be *universal* in its range. But it comes to be discovered that water, whilst conforming to it in its expansion from 39½° *upwards* to its boiling-point, as also, when it passes into steam, to the special law of expansion of vapours, is exceptional in its *expansion* also from 39½° *downwards* to its freezing-point; and of this failure in the universality of the law no *rationale* can be given. Still more strange is it, that by dissolving a little *salt* in water, we should remove this exceptional peculiarity; for *sea*-water continues to contract from 39½° downwards to its freezing-point 12° or 14° lower, just as it does with reduction of temperature at higher ranges.

Thus from our study of the mode in which we arrive at those conceptions of the orderly sequence observable in the phenomena of Nature which we call "Laws," we are led to the conclusion that they are human conceptions, subject to human fallibility; and that they *may* or *may not* express the ideas of the great Author of Nature. To set up these laws as self-acting, and as either excluding or rendering unnecessary the power which alone can give them effect, appears to me as arrogant as it is unphilosophical. To speak of *any* law as "regulating" or "governing" phenomena, is only permissible on the assumption that the law is the expression of the *modus operandi* of a governing power.—I was once in a great city which for two days was in the hands of a lawless mob. Magisterial authority was suspended by timidity and doubt; the force at its command was paralysed by want of resolute direction. The "laws" were on the statute book, but there was no power to enforce them. And so the powers of evil did their terrible work; and fire and rapine continued to destroy life and property without check, until new power came in, when the reign of law was restored.

And thus we are led to the culminating point of man's intellectual interpretation of Nature,—his recognition of the unity of the Power, of which her phenomena are the diversified manifestations. Towards this point all scientific inquiry now tends. The convertibility of the physical forces, the correlation of these with the vital, and the intimacy of that *nexus* between mental and bodily activity, which, explain it as we may, cannot be denied, all lead upward towards one and the same conclusion; and the pyramid of which that philosophical conclusion is the apex, has its foundation in the primitive instincts of humanity.

By our own remote progenitors, as by the untutored savage of the present day, every change in which human agency was not apparent was referred to a particular animating intelligence. And thus they attributed not only the movements of the heavenly bodies, but all the phenomena of Nature each to its own Deity. These Deities were invested with more than human power; but they were also supposed capable of human passions, and subject to human capriciousness. As the uniformities of nature came to be more distinctly recognised, some of these Deities were invested with a dominant control, while others were supposed to be their subordinate ministers. A serene majesty was attributed to the greater gods who sit above the clouds; whilst their inferiors might "come down to earth in the likeness of men." With the growth of the scientific study of Nature, the conception of its harmony and unity gained ever-increasing strength. And so among the most enlightened of the Greek and Roman philosophers, we find a distinct recognition of the idea of the unity of the directing mind from which the order of Nature proceeds; for they obviously believed that, as our modern poet has expressed it,—

> "All are but parts of one stupendous whole,
> Whose body Nature is, and God the Soul."

The science of modern times, however, has taken a more special direction. Fixing its attention exclusively on the *order* of Nature, it has separated itself wholly from theology, whose function it is to seek after its *Cause*. In

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this, science is fully justified, alike by the entire independence of its objects, and by the historical fact that it has been continually hampered and impeded in its search for the truth as it is in Nature, by the restraints which Theologians have attempted to impose upon its inquiries. But when science, passing beyond its own limits, assumes to take the place of theology, and sets up its own conception of the *order* of Nature as a sufficient account of its *cause*, it is invading a province of thought to which it has no claim, and not unreasonably provokes the hostility of those who ought to be its best friends.

For whilst the deep-seated instincts of humanity, and the profoundest researches of philosophy, alike point to mind as the one and only source of power, it is the high prerogative of science to demonstrate the *unity* of the power which is operating through the limitless extent and variety of the universe, and to trace its *continuity* through the vast series of ages that have been occupied in its evolution.

ON THE

COLLECTION AND ANALYSIS FOR GASEOUS CONSTITUENTS OF SAMPLES OF DEEP SEA-WATER.*

By W. LANT CARPENTER, B.A., B.Sc., F.C.S.

THIS paper was a summary of the author's experience on this subject in the "Porcupine" expeditions of 1869 and 1870. Many of the descriptions of apparatus employed, and of the conclusions from long series of analyses of 1869, had appeared in the *Proceedings of the Royal Society* for 1870. The analyses made in the summer of 1870 tended to confirm, in most points, those of 1869, and showed in addition that both surface and bottom waters contained more carbonic acid and less oxygen in the more southern than in the more northern latitudes. The examinations extended from the latitude of the Faroe Isles to that of Lisbon.

The main object of the paper, however, was to show that, contrary to the general supposition on the subject, there was no greater quantity of dissolved gaseous constituents in the bottom than in the surface water; and the author supported his position (which was generally accepted in the discussion which followed) by his own observations, and also by theoretical arguments, against such supposed excess, especially enquiring where the source of it was, while he fully admitted the power of the pressure at great depths to retain it in solution if it once were evolved there.

ON THE

PRESENCE OF ALBUMEN IN NEUTRAL FATS, AND A NEW METHOD OF OBTAINING STEARIC AND PALMITIC ACIDS.*

By W. LANT CARPENTER, B.A., B.Sc., F.C.S.,

IN the International Exhibition of 1871 there were exhibited several specimens of stearic acid, &c., by Professor J. C. A. Bock, of Copenhagen. It was stated that they were produced by a new process, which possessed very many advantages over any other known method. The author of this paper, having twice visited Copenhagen to study the process, and having extended its application to neutral fats other than tallow, in England, thought that an account of the scientific aspects of it might not be uninteresting to members of the Section. The inventor, Professor and State Councillor Bock, of Copenhagen, was by profession a medical man, formerly attached to the Danish Court, and a man of high culture and education, though but little known in England. He had been led up to his invention by patient microscopical and chemical study of the properties of neutral fats, and reflection upon the reasons of the disadvantages of methods hitherto practised. These disadvantages Mr. Carpenter pointed out at some length in his paper. Hitherto, when fats were decomposed by alkali, a considerable excess of alkali above the theoretical quantity was required, unless the operation were conducted under very great pressure, when the risk of explosion was great. When they were decomposed by sulphuric (or any other strong) acid, as was usually the case in England, much of the fat was lost by being charred and burnt, and the remainder was so black that it was necessary to distil it to render it good enough in colour for manufacturing purposes. The risk of fire, and of explosion in this operation was considerable, and the expense great. Professor Bock had shown that most neutral fats were made up of minute globules of fat, surrounded by albuminous envelopes, which form 1 to 1·5 per cent of the weight of the fat, and he considered that the excess of alkali, of pressure, or of heat required to decompose fats, was really used in the destruction and removal of these albuminous envelopes, which also attracted to themselves the colouring matters contained in the fat, or produced therein during its decomposition. The existence of the albumen could be demonstrated in the laboratory by dissolving the fat in ether or benzol, and precipitating the solution by water, or by boiling the fat on a *strong* solution of oxalic acid. In both cases the albuminous envelopes collected at the plane of junction of the two liquids. In Professor Bock's process the albuminous envelopes were broken and partly destroyed by the action, for a limited time, and at a given temperature, of a small quantity of strong sulphuric acid. The neutral fat then poured out from the envelopes in a state ready for decomposition by water in open tanks, an operation which required several hours for its complete performance. Its progress was judged of by microscopical examination of the crystals of the fat, or fatty acid, conformed by slowly cooling a thin layer upon a glass slip. When it was completed, the glycerine, which was dissolved in the water used for the decomposition, was drawn off, purified, and concentrated for sale. The fatty acids, amounting to 94 per cent of the original fat, were at this stage of a very brown or blackish colour. The next operation was to eliminate the albuminous envelopes, and with them most of the colouring matters. This was done by submitting the fatty acids in open tanks to the action of dilute solutions of certain oxidising agents, by which the black matters were partly oxidised, and their specific gravity greatly increased, so that when the oxidation had proceeded far enough they readily subsided to the bottom of the tank, leaving the fatty acids comparatively good in colour.* After two or three washings with dilute acid and water, the fatty acids were cold pressed and hot pressed in the usual way, and the result was a stearic acid higher in melting-point and greater in quantity than could be produced in any other way, and an oleic acid excellently fitted for the manufacture of soap and other purposes. One of the greatest advantages of the process was, that all operations were conducted in open tanks, boiled with steam not exceeding 35 lbs. pressure.

Mr. CARPENTER stated that he was at present engaged in applying this process to palm oil and other vegetable fats, and he illustrated his paper with specimens of the various stages of manufacture.

Abstract of a Paper read before the British Association, Brighton Meeting, Section B.

* The oxidising agents that had been employed were—the three strong mineral acids, sulphuric, nitric, and hydrochloric, permanganate and bichromate of potash, and hypochlorite of lime.

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PURE WROUGHT-IRON.

IT has hitherto been deemed impossible to make pure wrought-iron; this has recently been done on a large commercial scale at the Bowling Iron-Works, Bradford, by the Henderson process. The analysis of the pig-iron used is—

Graphitic carbon	3·155
Combined carbon	0·581
Silicon	1·646
Sulphur	0·070
Phosphorus	0·635
Manganese	1·472
Iron	92·644
	100·203

The wrought-iron from the above analyses—

	Per cent.
Carbon	0·272
Silicon	none
Sulphur	the barest trace
Phosphorus	none
Manganese	none
Iron, by direct determination	99·500
	99·772

ON DYES AND DYE-STUFFS OTHER THAN ANILINE.*

By Dr. F. CRACE CALVERT, F.R.S.

(Continued from p. 67.)

I SHALL now call your attention to three commercial preparations of indigo, obtained by the action of sulphuric acid on it. The first is called *sulpho-purpuric acid* or *phœnicine*, which is made by adding 1 part of indigo to 4 parts of highly concentrated sulphuric acid, heating for a short time, varying from half-an-hour to an hour, or until a small quantity of it mixed with a large quantity of water gives a deep purple colour. Great care must be bestowed on this part of the operation, so as to avoid the formation of a compound, to which I shall have again to call your attention, *sulpho-indigotic acid*. The acid mass produced is thrown into about 40 or 50 parts of water, when a beautiful purple precipitate is produced, which is collected on a filter, and slightly washed with weak muriatic acid. To dye wool with this sulpho-purpuric acid it is necessary to add to the bath a little muriatic acid, when it yields to the wool a fine dark purple-blue, that can be converted into various shades of purple by passing the wool so dyed in a bath containing a small quantity of carbonate or acetate of soda, which removes a small quantity of sulpho-indigotic acid that may be present, and gives rise to *sulpho-purpurate of soda*, which is a faster dye than the acid itself.

Sulpho-indigotic Acid is manufactured by dissolving 1 part of indigo in 10 or 12 parts of concentrated sulphuric acid, and heating the whole at a temperature of 120° F. very carefully for some hours. The operation is completed when a small quantity dissolves entirely in cold water.

The acids above described, when obtained perfectly pure, have the following formulæ:—Sulpho-purpuric acid, $C_{16}H_{10}N_2O_2,SO_3$; sulpho-indigotic acid, C_8H_5NO,SO_3.

Berzelius admits a third compound, called *hypo-sulpho indigotic acid*. These acids are transformed into neutral salts of soda, and sold under the names of neutral paste and carmine of indigo. They are prepared by neutralising the sulpho-acids with carbonate of soda, and the paste so formed is thrown on a wooden filter to remove the sulphate of soda which it contains, as well as a green colouring-matter, which is doubtless modified chlorophyl. The paste is then washed with a solution of chloride of sodium. It is a curious fact that carmines of indigo, which are perfectly soluble in pure water, are altogether insoluble in water containing either sulphate of soda or chloride of sodium.

Whilst speaking of the sulpho-indigotates, it may be useful to notice that the sulpho-indigotates of potash and soda are soluble in 100 to 150 parts of water, the sulpho-indigotates of lime, magnesia, and alumina are freely soluble, whilst those of baryta and lead are insoluble.

The carmines of indigo are especially used by silk-dyers, in consequence of the removal of the green colouring-matter above referred to, and which, if allowed to remain, would spoil the blue or purple which they wish to obtain. The method practically adopted to ascertain if the sample has been well washed, consists in rubbing a small quantity of it on a piece of glazed paper, which, when the colour dries, gives a colour varying from a pale blue to a rich copper purple, according to the mode of manufacture; and if any green colouring-matter is left in, it shows itself as a green ring round the blue circle.

The following may be taken as the composition of a sample of carmine of indigo of fair quality:—

Water	85·0
Indigo	10·2
Saline residue	4·8
	100·0

The sulpho-indigotic acids are especially used by woollen dyers, who add to the dye-beck a little alum and cream of tartar, which helps the fixing of the indigo on the wool. The green colouring-matter is in this case not objectionable, having no affinity for the fibre of wool.

The carmines of indigo, as well as the sulpho-acids, are easily decolourised by reducing agents, such as hydrogen and sulphuretted hydrogen, but they gradually reassume their original colour when exposed to the atmosphere, through the absorption of oxygen.

The above compounds, not being suitable for dyeing cotton, and not giving colours on silk and wool that may be considered fast, I shall now proceed to describe a few of the methods followed to obtain fast indigo blues. They are all based on the principle of the reduction of blue indigo into white indigo. The latter compound is held in solution by an alkali, which enables the dyer or printer to introduce it into the fibre of the fabric, where, on exposure to the atmosphere, the alkali combines with carbonic acid, and the white indigo thus liberated absorbs oxygen, and becomes insoluble blue indigo. The principal class of goods to which this chemical reaction is applied is to the vegetable fibres, linen, and especially cotton. As far as dyeing is concerned, the processes can be classed under two heads, hot and cold. The hot process is principally applied to wool, the cold to vegetable fibres, especially cotton.

The oldest and still most generally employed method of preparing cold vats, consists of putting into a vat containing about 2000 gallons of water, 60 lbs. of indigo, very finely powdered, 180 lbs. of slaked lime, and 120 lbs. of sulphate of protoxide of iron or green vitrol (free from any trace of copper salt), the two latter substances being added from time to time. The greater part of the lime used unites with the sulphuric acid of the iron salt, to produce sulphate of lime or gypsum, and the liberated protoxide of iron removes the oxygen from the indigo, becoming converted into saline oxide, whilst the reduced indigo dissolves in the excess of lime employed.

Messrs. R. Schloesser and Co., of Manchester, have introduced within the last year or two a marked improvement in the preparation of cold vats, which removes the great objections of the bulky precipitate of

* The Cantor Lectures, delivered before the Society of Arts. Revised and communicated by the Author.

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sulphate of lime, the formation of an oxide of iron, and the loss of indigo by its combination with the oxide of iron referred to in the previous part of the lecture. The bath remaining much more fluid, the pieces are less apt to be spotted, and a better class of work is produced. To carry out their process, they add to the ordinary 2000 gallon vat 20 lbs. of ground indigo, 30 lbs. of iron borings, 30 lbs. of their remarkable powdered zinc, and 35 lbs. of quick-lime; the whole is stirred up from time to time for 24 hours, when it is ready for use. If the bath is not considered sufficiently strong, a little more lime and zinc are introduced.

The chemical theory of the process is, that the zinc, under the influence of the lime, decomposes water, combining with its oxygen, and the hydrogen thus liberated, removes oxygen from the indigo, which then dissolves in the lime.

To dye cotton yarn in the above vats, it is simply necessary to dip it for a few minutes in the dye-bath, and expose it to the atmosphere, when the green hue it has acquired passes rapidly into blue. This operation is repeated until the yarn has attained the required depth of shade, when it is passed into weak vitriol, washed, and is ready for market.

To dye calicoes, the pieces are hooked on frames, passed through a bath of weak milk of lime, and then dipped into the reduced indigo vat. After fifteen minutes, the frame is taken out, and the cloth exposed to the air for about the same length of time. It is again dipped, the process being repeated until the required depth of tint is attained. It is then passed through weak vitriol, and washed. The cold vats are especially used when it is wished to obtain white and yellow designs on a blue ground; but when the object in view is to produce a self-colour, a more rapid process is adopted. This consists in passing the pieces through a dye-beck, then through an acid liquor, and lastly in water, by means of rollers fixed in the vat. The bath is composed of lime, sulphate of iron, and indigo, but is kept hot, instead of cold as in the former case.

There is still another process, which is now used to a limited extent only, but was at one time very extensively employed. It produces on the cloth a pale blue which has a great similarity of tint to that seen on the china porcelain, from which it derives its name of china-blue. To produce it the pieces are printed with a mixture containing very finely-powdered indigo, and a little acetate of iron, and are made to pass through six successive vats. The first two contain lime, the third sulphate of iron, the fourth a solution of caustic soda, the fifth a dilute solution of sulphuric acid, and the sixth water. When the design has acquired the required depth of blue, the pieces are washed, passed once more through weak sulphuric acid, and again washed. The chemical reactions are exactly similar to those in the cold vat process.

For dyeing wool, a modification of the old woad vat is employed. The use of woad being now almost entirely discontinued, I shall merely call your attention to the process in which indigo has been substituted for woad. It bears the name of Indian vat, doubtless from the process having been practised in India and imported from thence. It is as follows:—8 lbs. of powdered indigo is added to a bath containing 3½ lbs. of bran, 3½ lbs. of madder, and 12 lbs. of potash, which is maintained for several hours at a temperature of 200° F. It is then allowed to cool to 100° F., when fermentation ensues. After about 48 hours, the indigo is rendered soluble, being reduced, by the decomposition of the sugar and other products contained in the bran and the madder-root during the process of fermentation. The bath should have a greenish yellow appearance, having a frothy scum of a blue coppery hue.

Of late years, improvements have been made in this class of vats, by which the expense of using madder is avoided. They are now prepared by adding to water, at a temperature of 200° F., 20 buckets of bran, 26 lbs. of *soda crystals*, 12 lbs. of indigo, and 5 lbs. of slaked lime. After 5 hours, the bath is allowed to cool to 100° F., when fermentation ensues, and the indigo is dissolved in the alkali. The management of these vats require great experience and care, for if the fermentation is too slow, the indigo is not properly reduced, whilst if too active large quantities of indigo may be lost. The researches of Dr. Schunck, already referred to, not only show the method of avoiding this loss, but explain why it occurs. The remarks which I made as to the causes of failure in the manufacture of indigo are applicable here, namely, that if the fermentation becomes alcoholic and acetic, the non-oxidisable indigo compounds described by Dr. Schunck are generated.

I cannot leave the subject of indigo without bringing before you a most curious source of its production, namely, the human body. Medical men had observed from time to time that urine, secreted under certain pathological conditions, became brown, and sometimes even blue, when exposed to the atmosphere. The late Dr. Hassel discovered that in some instances the colouring matter was indigo, but here, again, we are indebted to Dr. Schunck for much information on the subject. In three papers presented to the Royal Society, he has proved that urine, in cases similar to those examined by Dr. Hassel, contained the glucoside of indigo, or indican. He also observed that indican was a very frequent constituent of urine secreted by persons in a healthy state, and, in fact, that it is produced generally when persons do not take sufficient exercise, and he has on several occasions succeeded in producing it by taking in his food a rather large excess of sugar.

(To be continued).

ON THE

EVIL EFFECTS OF THE USE OF ARSENIC IN CERTAIN GREEN COLOURS.*

By FRANK W. DRAPER, M.D.

(Continued from p. 54).

But in studying the reported cases of wall-paper poisoning, we need not confine our selections to observations made in other countries. Abundant testimony is afforded in our own midst; and this fact, that the pernicious effects of using the arsenical paper-hangings have been recognised and experienced here, and that cases have repeatedly occurred demonstrating the susceptibility and exposure of our own people, is of obvious importance and possesses a value which investigations at a distance could hardly be thought to have in comparison. The following are some of the instances which have been observed in this community:—

A well-marked case of poisoning occurred in 1863 in Boston, and was reported by Dr. W. E. Rice. The patient was a woman aged seventy-five years. After living a few days in a room which had had been papered with a bright green paper, she was attacked with a burning sensation in the throat and stomach, with frequent, though slight, vomiting after taking food. She had diarrhœa, with some dysenteric discharges; there was also great weakness, with trembling of the limbs and loss of appetite. Subsequently, severe cramps came on in the stomach and bowels; the skin was clammy; the voice was altered; pulse 100; bowels constipated; abdomen very tender on pressure. There was violent retching and vomiting on taking small quantities of either liquid or solid food. All these symptoms were much aggravated after sweeping or dusting the room. Proper treatment alleviated the distress; but when the room was again dusted, the symptoms recurred with renewed violence. The residence of the patient was now changed, and recovery followed. The paper was found,

* From the "Third Annual Report of the State Board of Health of Massachusetts."

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on examination, to contain arsenite of copper in its pigment.*

The notes of the following case were communicated to the writer by the individual who is the subject of the report:—In the autumn of 1859, a middle-aged lady, the wife of an eminent citizen of Boston, commenced to occupy a room which had been freshly decorated with wall-paper whose pattern consisted of alternate stripes of gilt and green flock; of the poisonous character of the latter she was wholly unaware. Excepting a neuralgia from which she had long suffered, she considered her health at this time to be perfect. Soon after beginning to habitually sit in the apartment she noticed a change in her feelings. The neuralgia, which previously had been only annoying, became intensified. She had headache and vertigo. There was nausea and distressing vomiting. The appetite was impaired; there was a dry cough and a bad taste in the mouth. Marked emaciation was manifest, and an almost intolerable sense of prostration and exhaustion ensued. All these symptoms compelled her to keep the room the more continuously. Remedies were meanwhile applied unavailingly, since the cause of the ailment was not detected. In the following summer, a stay of several months in the country was attended with distinct relief; but a return to the town residence was followed by a renewal of the painful experience, and during the winter months, while the room was occupied, the patient suffered distressingly. A second summer's absence brought a second season of respite, only to be followed by a third attack which renewedly baffled the skill of the attending physician. The symptoms at this period were of the most aggravated character. Frequent attacks of fainting, intense paroxysms of neuralgia, dizziness, almost incessant vomiting, and great prostration reduced the patient to the last extremity, and her life was despaired of. At this time, when the sufferer was almost moribund, it occurred to herself that the possible cause of all her deplorable state was in the green paper of her room. A sample was at once analysed by Dr. A. A. Hayes, and was pronounced by him to be "loaded with arsenic and extremely unsafe." From this discovery was dated the beginning of the patient's recovery. The paper was removed as soon as possible, but so fully had the patient's system become charged with the poison, and so depressing were its primary effects, that the consequences of the renewed infection are experienced to this day.

The colouring matter of the paper had become so loosely adherent that, on passing the hand or a cloth lightly over its surface, a distinct green stain was left. The workman who removed the paper from the walls was made seriously ill, although precautions were taken to prevent that accident; and it was ascertained also that the paper-hanger who had originally applied the paper was similarly poisoned.

Cases might be multiplied almost indefinitely; but it is believed that those which have been cited will suffice to demonstrate the fact that very harmful effects may and do result from the employment of an agent whose poisonous character is well recognised and whose sole recommendation by those who offer it displayed on the paper-hangings which are designed to decorate our walls is that it produces an attractive colour cheaply. These recorded instances exhibit a series of symptoms which, upon analysis, clearly show that the arsenical poisoning impresses itself on the human system locally as well as through its general influence. The local effects are precisely such as would be expected from the continued inhalation of an irritant agent, or from its presence in the atmosphere; the dryness of the throat and mouth, the inflammation of the mucous surface of the eye, the occasional salivation, the husky and altered voice, the severe frontal headache (about the frontal sinuses), the nausea and vomiting, the dry cough, all point to the action more or less marked and immediate on the various surfaces with which the poison comes in contact; while the more prolonged and insidious influence is indicated in the great debility and lassitude, the emaciation, the impaired nervous power, the irritability of disposition and depression of spirits, the muscular trembling, the occasional convulsions, the vertigo, the chilled extremities, the restless sleep, the pale cachectic aspect, the digestive disturbances, and the neuralgia, which comprise the general or constitutional symptoms. It is, of course, obvious that all these phenomena will not manifest themselves in the same individual as the results of exposure; nor will they present the uniformity which characterises other modes of poisoning. Of those in any degree affected, probably the majority would remark only the more primary and insignificant symptoms; for example, after a night's sleep in an apartment with the arsenical paper on its walls, the individual will notice a headache or a dryness of the mouth. It is only after prolonged exposure, or in persons specially susceptible, that the more serious effects are manifested. Thus it is by a careful criticism of the various symptoms presented in a given case, and by observing the fact that in the presence of the assumed cause no other cause can be discovered sufficient to account for these various local and constitutional symptoms, that we are enabled to arrive at definite conclusions. There are no distinct and characteristic effects which will allow the observer at once to discriminate such a case, as salivation enables him to do in mercurial poisoning, or as the blue line of the gums and wrist-drop, in poisoning by lead. It is, indeed, this very obscurity and want of uniformity characterising the effects of chronic arsenical poisoning from the cause in question that has led many writers to question, and not a few to deny, the possibility of the dependence of such a condition on this exposure. It will doubtless also explain the fact that comparatively few of these instances are recognised in their true and independent relation, and are reported as such; for it is plain that only the most unequivocal cases would be likely to see the light through the journals, and we are justified in inferring that a very great number of instances have occurred which, from their anomalous character, have escaped detection.

This feature is of evident importance as affecting the public health. If cases were habitually occurring presenting well-defined signs, and readily traced to their cause, the community would entertain no doubt concerning the course to be followed, and arsenical paper-hangings would very quickly become unfashionable. But the individual instances, like some of those cited, are in many respects perplexing and obscure, readily eluding the tact of the physician in his attempts to determine their true character, and baffling him in the application of his remedies; hence there is a vantage ground for scepticism on the one hand, and for ignorance on the other.

In this connection, it may be observed that the symptoms due to poisoning by arsenical paper-hangings are, notwithstanding the peculiarities above alluded to, strikingly similar to and, in many respects, absolutely identical with, those of chronic arsenical poisoning when the agent, swallowed in small and frequently repeated doses, exerts its cumulative action. These latter symptoms are notoriously varied in character and present many apparent anomalies. They follow little regularity of manifestation. In different individuals, they are exhibited sometimes with most emphasis in the digestive system, sometimes in the nervous system, and sometimes the influence is a general one and shows itself in a complication of symptoms. Thus it will be seen to be unnecessary to define a distinct train of phenomena as peculiar to poisoning by green wall-paper, since these offer no points of essential difference from those observed in ordinary chronic arsenical poisoning. The difference is one of degree, and depends on the more or less prolonged and continuous exposure to small amounts of the poison introduced into the system slowly and by indirect channels.

Although the fact that serious and sometimes very alarming disease follows, in certain cases, the use of arsenical-green wall-paper is of more consequence to the

* *Boston Med. and Surg. Journ.*, vol. lxix. (1863), p. 297.

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community at large than any discussion of hypotheses concerning the method of infection, this latter question is not without interest. Various theories have been advanced to explain the processes by which the poisonous pigment enters the system so as to produce its manifold pernicious effects. Gmelin, who first called attention to the subject in any of its relations, was of the opinion that the poison was absorbed as a volatile gas, the product of a "fermentation of the organic matters with which the arsenic is mixed." A little later, M. Louyet, of Brussels, declared that this gaseous exhalation was a special form of arseniuretted hydrogen, and based his theory on the observation that, when a mixture of arsenic and distilled water is allowed to stand a few days, the water at the end of that time gives out a distinct odour of garlic, which, as is well known, is characteristic of arsenic; and this evolution he thinks due to a decomposition of the water in the presence of arsenic. Analogously, the moisture which is almost always present in the walls of rooms undergoes a similar decomposition, evolving a volatile and very poisonous product. This view he thought strengthened by the presence of the alliaceous odour in rooms papered with the arsenical hangings. Basedow, a Prussian chemist of distinction, published similar opinions, the source of danger being attributed by him to the development, under the influence of moisture, of a certain amount of arseniuretted hydrogen. Other observers have adopted similar views, advocating the theory of gaseous decomposition, either from the presence of moisture,* or from slow combustion ("eremacausis") of the organic elements contained in the paper or its pigment,† or from the presence in the room of illuminating gas which escapes in small amount and reacts on the arsenite of copper to produce arseniuretted hydrogen.‡

All these theories of the evolution of a poisonous gas are to be distinguished from the absolutely untenable notion which was at one time accepted popularly, viz., that the poisoning took place by the inhalation of volatile arsenical fumes which escaped from the paper. This idea is obviously fallacious, since arsenic is volatilised and evolves "fumes" at a temperature of 360° F., 150° above the boiling-point of water.

These hypotheses are not accepted by the majority of chemists at the present day. It is the general belief that the poison escapes from the paper into the atmosphere in the form of dust, mechanically disengaged. This view seems not unreasonable in consideration of the composition of the paper and of the methods employed to engage the pigment in position. The connection between the paper and its colour, at the beginning depending only on the adhesiveness of size, certainly does not grow stronger with age. The paper is applied to the wall when moist with the paste or glue of the paper-hanger, and the size surrenders in this process something of its adhesive property. Varying states of the atmosphere, as they regard moisture and dryness, still farther carry on the change by which, with alternate drying and wetting, the pigment is less and less securely held. So that any mechanical violence, however small,—the action of drafts of air, or the passing of a duster, or vibration,—serves to disengage an impalpable powder containing the poisonous agent. It is well known that in the most unused room the air contains a certain amount of dust, so that a single sunbeam let into such a room when it is darkened reveals a perfect cloud of flying particles whose origin no one can tell. It is easy to see how the loosely adherent arsenical powder on the wall-paper of such a room may constitute a part of this dust, and the atmosphere become charged in greater or less degree with the pernicious agent. One element in the vexed problem of the relation of dust and disease thus finds solution.

This view has received confirmation in the fact that the dust resting on the furniture and mantels of such rooms has been tested, and has been found to contain the arsenic in considerable amount.

A third class of observers, including M. Kirchgässer, of Coblentz, and M. Chevallier, accept both these theories and allow a dual toxical influence. They admit all that is claimed for the dust hypothesis, but believe also, in view of the occasional detection of the odour of garlic or of mustiness in the suspected rooms, that under certain conditions of moisture a gas is generated, poisonous in character, which escapes to infect the air.

(To be continued.)

* *Otto Mohr.* † John Taylor. ‡ C. T. Jackson.

CORRESPONDENCE.

THE BRITISH ASSOCIATION AND THE MECHANICAL EQUIVALENCE OF HEAT.

To the Editor of the Chemical News.

SIR,—In 1870, the British Association paid £50 for experiments on the mechanical equivalence of heat. In 1871, a committee was re-appointed to examine and report on the subject.

The reports, &c., of the Sections were presented to-day, but this committee have made no sign. Surely they ought, in justice, to say what they have done, or what they have not done; what conclusions they have come to, or not come to; to make some statement or other. Section A refused last year to allow me to say anything on the subject: the committee will do nothing for themselves.

It is a very important subject, and it is unjust to stifle it. It seems to me clear that the doctrines enunciated by Professor Tait in his Thermodynamics must, to say the least, be much modified. Why not acknowledge it? I see that Dr. Maxwell, in his very recently published treatise "On Heat," has very much modified or explained away Tait's theory of the absolute zero of temperature.—I am, &c.,

H. HIGHTON.

Brighton, August 15, 1872.

MISCELLANEOUS.

British Association for the Advancement of Science.—The following is a complete list of the papers which were brought before Section B (Chemical Science) at the Brighton meeting, under the presidency of Dr. Gladstone, F.R.S., &c. They will be published, in full or in abstract, according to their importance, in the CHEMICAL NEWS.

The President's Address.

Report of the Committee for Investigating the Chemical Constitution and Optical Properties of Essential Oils used for Perfumes.

Prof. J. W. Mallet.—On the Fusion of Metallic Arsenic.

Prof. J. W. Mallet.—On the effect upon Meteoric Iron as regards the capability of being Forged, of previous heating to redness or whiteness, *in vacuo*.

W. Chandler Roberts.—On a Curve, Illustrating the British Gold Coinage.

W. Lant Carpenter.—On the mode of Collection of Samples of Deep Sea-Water, and of their Analysis for Dissolved Gaseous Constituents.

T. E. Thorpe.—On a New Filter-Pump.

Dr. Moffat.—On the Tube Ozonometer.

C. J. Woodward.—On a Modification of Hofmann's Apparatus for the Electrolysis of Water.

Preliminary Report of the Committee on Siemens's Electrical Resistance Pyrometer.

Report of the Committee for Superintending the Monthly Reports of the Progress of Chemistry.

Dr. Gladstone and Mr. Tribe.—On the Mutual Helpfulness of Chemical Affinity, Electricity, and Heat in the Decomposition of Water.

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J. Dewar.—On Specific Heats at High Temperatures.
J. W. Mallet.—On the Occurrence of Native Sulphuric Acid in Texas.
J. W. Mallet.—On the Occurrence in recent Pine Timber of Fichtelite, a hydrocarbon hitherto only known in a fossil state.
W. Weldon.—On the Manufacture of Chlorine by Manganite of Magnesium.
F. C. Calvert.—On the Composition of Bleaching-Powder.
A. Tribe.—On the Precipitation of Silver by Copper.
G. Gladstone.—On the Dust thrown up by Vesuvius in the Recent Eruption.
Dr. Schenck.—On the Amounts of Heat required to Raise Elementary Bodies from the Absolute Zero to their State of Fusion.
W. Lant Carpenter.—On the Presence of Albumen in Neutral Fats, and on a New Process for the Manufacture of Stearic and Palmitic Acids.
J. F. Walker.—On Dinitrobrombenzine.
C. R. A. Wright.—On New Derivatives from Morphine and Codeine.
J. Williams.—Preliminary Note on the Preparation of Gavanine.
J. A. Wanklyn.—On some New Methods of Analysing the Ethers.
Rev. H. Highton.—On a Powerful Galvanic Battery.
Prof. Crum Brown.—On Chemical Nomenclature.
Dr. T. Wood.—On the Teaching of Elementary Chemistry.
Dr. Gladstone.—On Filiform Native Silver.
G. Unwin.—To Exhibit Specimens of Agate and other forms of Natural Colloid Silica.
J. A. Wanklyn.—On the Continuous Production of Oxygen.
J. B. Grantham.—Report on the Utilisation of Sewage.
W. J. Cooper.—On a Proposed Method of Preventing the Fermentation of Sewage. (Discussion on the Report on the Utilisation of Sewage.)
Herr von Rath.—The Crystallographic System of Leucite.
Dr. Ord.—Crystallisation of Salts in Colloid Solutions.
Dr. Oppenheim.—The Action of Phosphorus on Alkaline Solutions of Metals.
John Galletly.—Ignition of Cotton by Saturation with Fatty Oils.
James Howell.—On the Minerals lately Found in the Drainage Works at Brighton. (With Specimens.)

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Place of Meeting for Next Year.—The meeting next year will be held at Bradford, commencing on September 19. President Elect—Dr. James P. Joule, LL.D., D.C.L., F.R.S. Belfast has been selected for the meeting of 1874.

University of London—First B.Sc. and Preliminary Scientific (M.B.) Examinations.—The following are among those who presented themselves for the Examinations for Honours:—*Mathematics and Mechanical Philosophy.*—First Class. J. M. Lightwood, First B.A. (Exhibition), Trinity Hall, Cambridge; R. H. Jude, First B.Sc., Christ's College, Cambridge. Second Class. J. F. Main, First B.Sc., private study. *Chemistry.*—First Class. R. E. Carrington, Prel. Sci. (Exhibition), Guy's Hospital; B. A. Whitelegge, Prel. Sci., University College. Second Class. H. B. Briggs, Prel. Sci., King's College; H. D. Stewart, Prel. Sci., King's College; R. H. Jude, First B.Sc. and Prel. Sci., Christ's College, Cambridge; F. Goodchild, Prel. Sci., Epsom and University Colleges; A. S. Napier, First B.Sc., Owens College; W. B. Worthington, First B.Sc. and Prel. Sci., Owens College. *Organic Chemistry, and Materia Medica and Pharmaceutical Chemistry.*—First Class. W. B. Houghton (Exhibition and Gold Medal), University College; H. R. Crocker (Gold Medal), University College; P. T. Duncan, University College. Second Class. A. P. Gould, University College; G. E. Herman, London Hospital.

Fluorescence.—At the meeting of the American Institute, President Henry Morton, of the Stevens Institute of Technology, read a paper on "Fluorescence," or that action by which rays of the higher purple, or even invisible light, such as produce most strongly photographic action, excite in certain bodies lower rates of vibration, resulting in the emission of light, generally of a red, green, or clear blue colour. This paper was illustrated by a number of striking experiments. Thus, a flask of solution of chlorophyl (a green colouring-matter obtained from leaves), which is of an olive-green colour, being held in a beam of blue light proceeding from a "vertical lantern" appeared to be full of a blood-red liquid. Various solutions colourless in ordinary light were then shown to exhibit the brightest hues when illuminated by the violet rays of the lantern, or those obtained from the electrical discharge of the Professor's large coil in rarefied gases. The speaker then announced that in the course of the examination which he had been making of such substances, he had encountered one which he believed to be as yet unknown, and which possessed the property of developing light by fluorescence in a pre-eminent degree. This body was obtained from petroleum, and he would propose to take for it the name "Viridin." The word viridin had been already applied as a synonym for chlorophyl, but was now practically obsolete, and too appropriate to the present substance to be thrown away. A large drawing of a flower, with leaves painted seemingly in light umber tints, was then shown and illuminated by electric discharges, when it appeared of the most vivid green. The peculiar fluorescent spectrum of this body, and its relations to the spectra of other substances, was explained, and many other illustrations were exhibited.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, August 12, 1872.

This number contains the following original papers and memoirs relating to chemistry:—

Mode of Division of One Base between Several Monobasic Acids when together in Aqueous Solution.—Dr. Berthelot.—A physico-chemical essay elucidated by several tables exhibiting results of experiments and theoretical calculations.

Conversion of Dextro-Rotating Tartaric Acid into Racemic Acid.—E. Jungfleisch.—The main gist of this essay is that optically active, or dextro-rotating tartaric acid is, when heated along with water in sealed tubes to 175°, converted almost entirely into racemic

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acid. The author has made this experiment on a large scale in a Papin pot made of wrought steel, and enamelled inside, and found that the result is the same when the vessel is carefully heated in an oil-bath up to 180°.

Although not strictly belonging to chemistry, we quote the title of the following memoir:—

Report on the Carboniferous Flora of the Département de la Loire.—M. Grand Eury.—This exhaustive paper is an important contribution to our knowledge of the plants which have been converted into coal.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 14, 1872.

This number contains the following original memoirs and papers:—

Bromated Chlor-Salylic Acid and Bromated Chlorobenzoic Acid.—A. Claus.—After briefly referring to the researches of Drs. Beilstein, Kuhlberg, and Pfeiffer on this subject, the author states that the best method of obtaining the bromated compound of these acids is to treat their silver salts with bromine. The bromated chlor-salylic acid is a solid crystalline body, fusing at 151°, and subliming, without decomposition, at 160°. 1 part of this acid is soluble in 380 parts of water at 21°; most of its salts are also freely soluble in water. The formula is $C_7H_4BrClO_3$. Bromated chlorobenzoic acid is also a solid, crystalline body, more difficultly soluble in water than the former acid (1 part requires, at 0°, 2840, and at 21°, 1080 parts of water for solution); at 160°, this substance also sublimes without decomposition. In the preparation of chlorobenzoic acid from benzoic acid and a mixture of chlorate of potassa and hydrochloric acid a large quantity of dichlorobenzoic acid is formed.

Thio-Isopropyl Alcohol and Isopropyl-Sulphonic Acid.—A. Claus.—After describing at great length the mode of preparation of thio-isopropyl alcohol, it is stated that that substance is a fluid lighter than water, soluble in every proportion in alcohol and ether, and not quite insoluble in water, from which solution the mercury combination of the alcohol is obtained upon the addition of mercuric chloride. Concentrated nitric acid decomposes thio-isopropyl alcohol with violence; but with dilute nitric acid the reaction is moderate, and attended for a few moments by a very brilliant purplish colouration, which disappears, the result of the reaction being the formation of sulphuric acid and a new organic acid. The formula of thio-isopropyl alcohol is C_3H_8S. Isopropyl-sulphonic acid, $C_3H_7.SO.OH$, is the new organic acid alluded to, and a solid crystalline body fusing at below 100°, forming crystalline salts.

Synthesis of Sulphuretted (Geschwefelte) Tannic Acids.—H. Schiff.—Notwithstanding its intrinsic merits, the contents of this lengthy essay, elucidated by a large number of complex formulæ, are not well suited for useful abstraction, an observation also applying to the following paper.

Constitution of Coumarine.—H. Schiff.

Mesoxalic Acid.—J. Ossikovszky and G. Barbaglia.—The authors tried in vain to obtain free mesoxalic acid, by first converting chloroxalic acid ethyl-ether into a cyanogen compound, and next saponifying that body. Every experiment made to convert the cyanogen compound into COOH failed. The authors describe the mode of preparing acetyl-oxaminic acid ethyl-ether, a solid crystalline substance, percentically consisting of—C, 45·28; H, 5·66; N, 8·74. When boiled with water this body is decomposed.

Contribution to our Knowledge on Guanidin.—J. Ossikovszky.—The preparation of guanidin according to Bannow's method, viz., treatment of iodide of cyanogen with three times its weight of alcoholic ammonia solution at 10 per cent in sealed tubes at 100°, does not, according to the author, give quite satisfactory results, only a small quantity of guanidin being obtained after purifying the crude product. By taking up, under the influence of either boiling dilute sulphuric acid or of alkalies, the elements of water, guanidin is split up, yielding first urea and ammonia; the former is again converted into carbonic acid and ammonia by taking up water.

New Method of the Formation of Amides and Nitriles.—E. A. Letts.—This excellent and exhaustive monograph is divided into the following sections:—Action of acetic acid upon sulpho-cyanide of potassium; action of isobutyric acid upon sulphocyanide of potassium; action, respectively, of valerianic, benzoic, cuminic, and cinnamic acids upon sulphocyanide of potassium.

Dimethyl-Anthracen.—A. van Dorp.—The author describes, at length, the synthetical preparation of dimethyl-anthracen, by treating xylyl-chloride with water at a high temperature in a sealed tube. By that operation an oily body is obtained which, when it is passed through red-hot tubes filled with pumice-stone, is converted into dimethyl-anthracen. This material is very like anthracen, and fuses at 200°; when dissolved in glacial acetic acid and oxidised by chromic acid, an oxidation product is obtained which is at present the subject of the author's research.

Crystalline Shape of Hydrate of Chloral.—P. Groth.—A strictly crystallographical memoir.

Contribution to our Knowledge of the Aromatic Addition Products.—C. Graebe.—This monograph is divided into the following sections:—Introduction, containing a general review of the compounds obtained by the addition of hydrogen to the aromatic compounds; naphthalin-tetrahydride, $C_{10}H_{12}$; cymen, $C_{10}H_{14}$; reduction of cymol.

Diphenyl.—G. Schultz.—This paper contains the preliminary account of some results of researches undertaken with the view of *ascertaining more correctly* the constitution of the aromatic hydrocarbons. The author treats on the preparation and oxidation of diphenyl, on monobrom-diphenyl, oxidation of dibrom-diphenyl, and on reduction of diphenyl.

Some of the Derivatives of Benzyl-Toluol.—Th. Zincke.—This essay treats on—(1) the action of bromine upon benzyl-toluol, $C_6H_5{-}{-}CH_2{-}{-}C_6H_4{-}{-}CH_3$; (2) action of nitric acid, dinitro-benzyl-toluol, $C_{14}H_{12}(NO_2)_2$; (3) nitro-methyl-benzophenon, $C_6H_4(NO_2){-}{-}CO{-}{-}C_6H_4{-}{-}CH_3$, or—

$$C_6H_5{-}{-}CO{-}{-}C_6H_3(NO_2){-}{-}CH_3;$$

(4) tetra-nitrobenzyl-toluol, $C_{14}H_8(NO_2)_4$; (5) action of fuming sulphuric acid, benzyl-toluol-disulpho acid, $C_{14}H_{12}(SO_2H)_2$, and the salts of that acid.

Benzyl-Ethyl-Benzol.—J. T. Walker.—This body—

$$C_6H_5{-}{-}CH_2{-}{-}C_6H_4{-}{-}C_2H_5,$$

the mode of preparation of which is described at length, is a colourless liquid, exhibiting a faintly aromatic odour; sp. gr. at 18·9°, 0·965; readily soluble in alcohol, ether, and chloroform; boils at from 290° to 295°. By oxidation, this hydrocarbon (consisting, in 100 parts, of—C, 91·84; H, 8·16) yields benzoyl-benzoic acid.

Benzyl-Sulpho Acid.—G. Barbaglia.—This memoir treats on the preparation of benzyl-sulpho acid by means of the oxidation of the sulphur compounds of benzyl.

Some of the Derivatives of Benzylamine.—J. Strakosch.—This essay is divided into the following sections:—Introduction, treating on monamines in general, and on the best modes of preparation of benzylamine; cyanbenzylamine; action of chlorcyan upon benzylamine; cyanbenzylamide; tribenzyl-melamine; dibenzyl-guanidin; dibenzyl-sulpho-urea; benzyl-acetamide; nitrobenzyl-mercaptan; nitrobenzyl-sulphide.

Observations on Isobutyl-Aldehyde.—A. Pfeiffer.—In the first part of this essay the preparation of the isobutyl-aldehyde is described at length. In pure state, this substance is a colourless, strongly refrangible liquid, which yields with ammonia a rather difficultly crystallising compound. Isobutyraldin is, in crude state, an amorphous solid mass, which, however, may be obtained in crystalline state by repeated treatment with ether. Carbo-isobutyraldin, $C_9H_{18}N_2S_2$, obtained by treating isobutyl-aldehyde with sulphide of carbon, is a solid body fusing at 91°.

Phenyl-Diacetic Acid.—R. Biedermann.—After first referring to the researches of Grimaux on this subject, the author records at great length the rather circuitous mode of preparation of this substance, the formula of which is—

$$C_6H_4\begin{cases}CH_2.CO.OH\\CH_2.CO.OH\end{cases}$$

It is an amorphous, solid substance, fusing at 236°, but becoming decomposed at the same time.

Synthesis of Aromatic Monamines by Conversion of Atoms (Atomwanderung) into Molecules.—Dr. A. W. Hofmann.—This lengthy monograph is divided into the following sections:—Investigation of the amines formed at a moderately-elevated temperature; investigation of the amines formed at a high temperature.

Conversion of Aniline into Toluidine.—Dr. A. W. Hofmann.—The preliminary account of some researches concerning which a more extensive paper will be published.

Action of Ammonia upon Nitranisic Acid and Griess's Phenyl-Diamine.—H. Salkowski.—Notwithstanding the intrinsic value of this essay, elucidated by complex formulæ, its contents are not well suited for useful abstraction.

Bulletin de l'Academie Royale des Sciences, des Lettres et de Beaux Arts de Belgique, No 6, 1872.

This number contains no original papers relating to chemistry, but we call attention to the two following memoirs:—

Lightning-Conductor Lately Destroyed by Lightning at Wetteren (West Flanders).—Drs. Gloesener and Maas.—It appears that a lightning-conductor had been placed on a church recently built in this town, but it was not so contrived as practical experience has proved to be necessary to ensure a safe passage of the electric discharge, and, during a severe thunderstorm on May 23 last, the conductor was struck and broken in two places, the result being serious injury to the building. The authors examined the rods immediately after the accident, and illustrate, by means of an engraving, the damage done; they observe that, unless lightning-conductors are made with care, and tested by means of a weak galvanic current and galvanometers, they may, instead of acting as a protection, be a source of danger and serious injury to surrounding buildings.

Newly-Executed Exploration of the Bone Cavern at Engis, near Liège.—E. Du.—Illustrated with several engravings and map. This paper contains an account of the author's search for fossil bones and flint implements.

Les Mondes, August 15, 1872.

Death of M. Delaunay.—With regret we record the death of this eminent *savant*, who was drowned while bathing in the sea at Cherbourg on the 4th inst. As Director of the National Observatory at Paris, the deceased was at the head of French astronomers; he was, moreover, a scientific man of high standing, and his decease, at the early age of 56 years, will be severely felt in his native country, and be deeply regretted by all scientists who knew the value of his researches and labours.

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White-Coloured Aurora Borealis.—A. Cheux.—The detailed account of the scientific observations of this phenomenon as seen at the observatory of Baumette, near Angers (France).

Observatory at Toulouse.—Rev. F. Moigno.—It appears that an astronomico-meteorological observatory, which is to be established in this ancient city, will be placed under the care of a visiting committee and director, presided over by the Mayor of Toulouse.

Electric Clockwork.—C. F. Mildé.—The exhaustive description, illustrated by several engravings, of machinery for indicating true mean time by the aid of one good clock.

Various Methods of Applying Osmose to Sugar Refining.—M. Dubrunfaut.—By osmose, the author understands a process by which the saline matter, which may impede the crystallisation of sugar, is eliminated, the operation being based upon the different degree of diffusibility of sugar and saline matter, viz., salts of potassa, soda, ammonia, and magnesia, but neither lime nor colouring matter. It appears that many beet-root sugar makers apply this method in all its technical details.

Iris Observed on the Lake of Genève.—Dr. E. Wartmann.—The account of a luminous effect of the solar rays lately observed by the author on the banks of this peculiar lake. It appears that this phenomenon is not uncommon on Lake Leman, it having been noticed in 1869.

Behaviour of Cadmium, Iron, and Tin in Nitric Acid.—Dr. Schönn.—The author states that the action of nitric acid on iron alters its nature; this is shown by its being incapable of reducing copper when immersed into a solution of that metal. Cadmium is not acted upon by nitric acid if a platinum wire is wound round the rod of metal when immersed in the acid, and the same obtains with tin. It would appear that the electric condition of the metals being altered is the cause of the effects observed.

Fulminatine.—Rev. F. Moigno.—Under this title a new explosive compound is in use, consisting of nitro-glycerine, silica, and 15 per cent of a peculiar substance, the composition of which is kept secret, but which is, on ignition, entirely converted into gaseous matter.

Pharmaceutische Zeitschrift für Russland, No. 1, 1872.

Ammonium Compound of Cantharidine.—Dr. E. Masing.—Cantharidine combines with ammonium, but this body is a rather unstable compound, and cannot be obtained in solid state except by evaporation of the solution of cantharidine in ammonia *in vacuo*. The formula of this substance is—

$$\left.\begin{matrix} NH_4 \\ C_{10}H_6''O_3 \\ C_{10}H_6''O_3 \\ H \end{matrix}\right\} O_6$$

In 100 parts—84·85 of cantharidine, and 7·79 of ammonium. The author mentions that other compounds of these bodies exist, and also speaks of an amido combination of cantharidine which is soluble in chloroform.

No. 2, 1872.

In addition to papers more particularly belonging to pharmaceutical science, this number contains the following memoir relating to chemistry:—

Quantitative Estimation of the Alkaloids Contained in Ipecacuanha, Aconite, Nicotiana, and Conium.—Dr. O. Zenoffsky.—The first instalment of an exhaustive monograph on this subject; the author reviews, in this portion, the various methods proposed for estimating the quantity of emetine present in the drug, and gives a comparative review of the results obtained by the application of the various methods. He lastly describes a plan of titration whereby, from a given quantity of ipecacuanha treated with proper solvents, the emetine may be rapidly determined; the quantity of this alkaloid present in the root varies, according to the quality of the root, from 2·425 to 3·89 per cent.

No. 3, 1872.

This number contains the concluding portion of the above essay. The author points out the best and most reliable methods for quantitatively estimating aconitine, nicotine, and coniine.

La Revue Scientifique de la France et de l'Etranger, August 17, 1872.

This number contains no original papers relating to chemistry, but we call attention to the following essay:—

Analysis of Soil by Plants.—Dr. G. Ville.—The continuation of the author's course of lectures on practical agriculture in the experimental field at Vincennes.

Polytechnisches Journal von Dr. E. M. Dingler, second number for July, 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral subjects:—

Bunsen's New Chromic Acid Galvanic Battery.—J. Müller.—This algebraico-physical essay contains the account of a series of experiments for testing the efficacy of a Bunsen battery in which, instead of nitric acid, a mixture of bichromate of potassa and sulphuric acid is employed.

Bessemer and Cast Steel.—Dr. Dingler.—This paper treats on the relative quality of the two kinds of steel, and on the comparative value of both for technical use.

Pyrometrical Assay of the so-called Dinas Fire-Bricks and Dinas Sandstone.—Dr. C. Bischof.—This memoir records the results of a series of pyrometrical experiments made for the purpose of testing the fire-resisting quality (degree of infusibility) of these materials, which are made at Neath, South Wales. It appears that the bricks, as well as the cement and sandstone, are in a very high degree refractory, on account of containing hardly anything else than silica.

Adulteration of Ultramarine.—C. Fürstenau.—This paper contains an account of a method of mixing with genuine ultramarine white-coloured substances, such as fibrous gypsum, alabaster, and sulphate of potassa, so as to produce a deep blue, but largely weighted, ultramarine, which, however, is of course much less suitable for use.

Testing Bees'-Wax for Adulterations.—E. Donath.—The author reviews, in this paper, the labours of Landolt, Breitenlohner, Dullo, Wagner, Fehling, and others on the subject of the many adulterations of white, as well as yellow, bees'-wax. Paraffin, white resin, tallow, stearic acid, and Japanese wax are the chief adulterants. The author recommends the estimation of the sp. gr. of the substance to be investigated, and describes an apparatus, illustrated by a woodcut, for this purpose.

Contribution to the Technology of the Tanning Materials.—Dr. R. Wagner.—This monograph treats on the leather-making substances, viz., sumac, oak-bark, valonia, and bablah. The author observes that tannin (tannic acid) is not a material which is capable of producing leather with corium, and that the relative value of the tanning materials depends, not only upon the quantity of tannin they contain, but also upon accessory substances as yet only very imperfectly known.

Studies for Establishing a Scientifically-Arranged Tanning Method.—A. Reimer.—The first instalment of this lengthy monograph, divided into the following sections:—Introduction, containing a *resumé* of the labours of Dr. Knapp and others on this subject; skin; the material which causes the agglutination of the fibres; pure fibre.

Removal of Ink-Stains from Coloured Woven Tissues.—Dr. Böttger.—The author recommends the use of pyrophosphate of soda for this purpose, the salt to be applied in concentrated solution. The recent ink-stains are readily removed, but older stains require washing and rubbing with the solution for a long time.

Annalen der Physik und Chemie, von Dr. J. C. Poggendorff, No. 7, 1872.

This number contains the following original papers and memoirs relating to physico-chemical sciences:—

Passage of Caloric Rays through Diathermane Plates when Placed in an Inclined Position.—H. Knoblauch.—An algebraico-physical monograph, illustrated by a series of tables containing results of experiments.

Experimental Researches on Fluorescence.—E. Hagenbach.—The continuation of an exhaustive memoir on this subject.

Influence of the Astronomical Motion on Optical Phenomena (viz., of the Light emitted by the Sun, Stars, &c.).—The continuation of a valuable essay on this subject.

Evolution of Heat by Friction between Fluids and Solids.—O. Maschke.—The description, chiefly in the shape of tables, of a series of results of experiments made with amorphous siliceous substances converted into small granules, and water in a peculiarly-arranged apparatus, so contrived that the amount of heat evolved by the absorption of the water by these substances could be accurately ascertained.

Magnetising Function of Soft Iron, and more particularly under the Influence of Feeble Dispersing Power.—Dr. A. Stoletow.

Meteorite which fell June 17, 1870, at Ibbenbühren (Prussia).—G. vom Rath.—This essay, illustrated by engravings exhibiting views of the meteorite, treats at length on the phenomena observed by the falling of the stone, which mineralogically is composed of enstatite or bronzite—

$$\left.\begin{matrix} Mg \\ Fe \end{matrix}\right\} SiO_3.$$

Hail-Stones of Unusual Size and Shape.—A. Moritz.—The account of a severe hail-storm observed at Bjeloi-Kliutsch near Tiflis (Russia), at 41° 10′ N. lat. and 62° 19′ E. long., illustrated with engravings representing the size and shape of the hail-stones.

Microscopical Structure of Hail-Stones.—J. H. L. Flogel.—A memoir illustrated with engravings.

Apparatus for Exhibiting the Phenomenon of the Freezing of Water.—Dr. G. Krebs.—Illustrated by woodcuts.

Journal für Gasbeleuchtung und Wasserversorgung, Nos. 9, 10, and 11, 1872.

These numbers only contain papers relating to gas- and water-works' engineering.

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NOTES AND QUERIES.

Test for Anthracen.—(Reply to D. G.)—Peruse Vols. 24, 25, and 26 of Chemical News, and also Dr. Kopp's memoir in *Moniteur Scientifique Quesneville.*

Lamp for Water-Oven.—(Reply to "Albion.")—Try a paraffin oil lamp with Argand burner, and get a copper chimney to it. Such a lamp gives a great heat, and can be regulated to suit any temperature.

Pure Aluminium.—(Reply to E. Purdon.)—You can only prepare this metal by decomposing solid chloride of aluminium with sodium. For the full method of manipulation consult Dr. W. A. Miller's work on Chemistry.—*Z.*

Dryer for Tarry Substances.—I shall feel obliged if any of your readers can inform me what dryer to use (a cheap one) to make tarry substance dry quicker. I do not mind if the lasting property of the tar is deteriorated a little.—C. E.

Manufacture of Iodine.—Can any of your readers inform me if there is any change or improvements in the manufacture of iodine other than the old method of preparing it from the mother-liquor of kelp; if so, will they kindly give a description of such improvements.—Medicus.

Hydrocyanate of Morphia.—(Reply to J. H. L. Schumann)—Dr. Duflos does not mention the salt you speak of, and considering the volatility and instability of hydrocyanic acid, it is not likely that a solid compound of that acid and morphia exists. There exists a cyanide of bismuth, obtainable by precipitating a solution of neutral nitrate of bismuth with cyanide of potassium, but that compound should not be used in medicine. Dissolve some *pure* carbolic acid in water, or better still, in dilute acetic acid, and steep the meat in it for some hours. The time of immersion must depend upon the size and weight of the meat; it is then dried and cured as smoke-dried meat. —A. A.

PATENTS.

Communicated by Messrs. Vaughan and Son, Patent Agents, 54, Chancery Lane, London, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

2276. W. B. G. Bennett, Nichols Square, Hackney Road, Middlesex, and J. C. Watt, Lancaster Road, Notting Hill, Middlesex, "Improvements in the preparation of asphalte, and in the application thereof to the construction of roads and footpaths, and other purposes."

2286. A. Browne, Gracechurch Street, London, "Improvements and modifications in the treatment of phosphate in general, and in the production and purification of phosphoric acid and its combinations."—A communication from H. Storck, E. Hentsch, A. Hentsch, A. Lutscher, and F. Grininger, Paris.—Petitions recorded July 30, 1872.

2318. J. Henderson, New York, U.S.A., "Improvements in converting cast-iron into steel and wrought-iron, and purifying cast-iron for foundry and other purposes."—Petition recorded August 3, 1872.

2331. C. M. T. du Motay, Boulevard de Strasbourg, Paris, "An improved mechanical and chemical method of epurating the cast-irons, in order to allow the same to be directly or indirectly transformed into iron or steel."—Petition recorded August 5, 1872.

2341. C. Morfit, Baltimore, Maryland, U.S.A., "Improvements in the manufacture of pure phosphates of lime."—Petition recorded August 6, 1872.

2351. G. M. Moore, Liverpool, "Improvements in the process of evaporating or concentrating alkaline liquors in the manufacture of caustic soda, caustic potash, soda ash, and other similar substances; also for heating or boiling and refrigerating solutions in breweries, distilleries, chemical and other manufactories, and in the apparatus employed therefor."—Petition recorded August 7, 1872.

INVENTIONS PROTECTED BY THE DEPOSIT OF COMPLETE SPECIFICATIONS.

2369. W. R. Lake, Southampton Buildings, London, "Improved nutritious compounds."—A communication from J. R. Weed, New York, U.S.A.—Recorded August 9, 1872.

2389. H. A. Bonneville, Rue de la Chaussée d'Antin, Paris, "A new or improved process of manufacturing cast-steel."—A communication from H. A. Levallois, Rue de Chabrol, Paris.—Recorded August 10, 1872.

NOTICES TO PROCEED.

954. V. Caratti, Brixton, Surrey, and S. K. Church, Fenchurch Street, London, "Improvements in heating, and in generating hydrogen for that purpose."—Petition recorded March 30, 1872.

989. J. C. Sellars, Birkenhead, Cheshire, "Improvements in obtaining hydrocarbon liquid gas for illuminating and heating purposes, and coke."—Petition recorded April 4, 1872.

1065. L. A. Badin, New Ormond Street, Middlesex, "A new or improved method of deodorising human excrementitious matters, and of its manufacture into farm manure, suitable for all descriptions of agricultural purposes, and to all localities."—Petition recorded April 11, 1872.

1089. J. Anderson, Newbuildings, Londonderry, Ireland, "Improvements in refining iron, in obtaining malleable iron and steel, and in apparatus therefor."—Petition recorded April 12, 1872.

1456. W. Clark, Chancery Lane, Middlesex, "An improved method of extracting anthracene contained in coal-tar and the pitch accruing therefrom, without either carbonising or decomposing the pitch."—A communication from P. Audouin, Paris.—Petition recorded May 13, 1872.

1586. W. R. Lake, Southampton Buildings, London, "Improved processes and apparatus for the extraction of oil and the production of flour from maize."—A communication from H. C. Cavayé, Paris.—Petition recorded May 24, 1872.

1608. J. H. Selwyn, Gloucester Crescent, Hyde Park, Middlesex, "A new method of treating refractory ores of silver."—Petition recorded May 27, 1872.

2261. W. E. Gill, Salisbury Street, Strand, W.C., "Improvements in treating vegetable juices, and in the apparatus and materials to be employed therefor."—Petition recorded July 29, 1872.

PATENTS SEALED.

476. T. Rowan, Glasgow, N.B., "Improvements in preparing carbonates or oxides of lead and zinc for use as pigments and otherwise."—Dated February 15, 1872.

508. J. Hargreaves and T. Robinson, Widnes, Lancashire, "Improvements in the production of chlorine and hydrochloric acid, and in apparatus employed therein."

509. J. Hargreaves and T. Robinson, Widnes, Lancashire, "Improvements in the manufacture of alkalies, and in apparatus employed therein."

513. J. Anderson, Newbuildings, Londonderry, Ireland, "Improvements in reducing oxides, and in obtaining iron, sodium, potassium, phosphorus, chlorine, or their compounds, and in apparatus therefor."—Dated February 17, 1872.

547. S. W. Rich, Chenies Street, Middlesex, "An improved process for treating aluminous schist or shale."—Dated February 20, 1872.

572. B. Hunt, Serle Street, Lincoln's Inn, Middlesex, "Improvements in the manufacture of leather, and in the processes and compositions to be employed therein."—A communication from J. C. White, Quincy, Illinois, U.S.A.—Dated February 22, 1872.

1162. H. Warry, Parkstone, Dorset, "Improvements in various beverages."—Dated April 18, 1872.

1752. C. F. Hengst, Fulham, Middlesex, and J. B. Muschamp, Kensington, Middlesex, "Improvements in the manufacture of gas, and in the apparatus employed therein."—Dated June 11, 1872.

1795. J. Imray, Southampton Buildings, Middlesex, "Improvements in the manufacture of iron and steel, and apparatus therefor."—A communication from T. S. Blair, Pittsburg, Penn., U.S.A.—Dated June 14, 1872.

1880. W. Morgan Brown, Southampton Buildings, London, "An improved apparatus for extracting ammonia, in the form of liquid ammonia, from crude ammoniacal liquors."—A communication from J. H. Elwert, Geneva, and J. J. M. Pack, Basel, Switzerland.

1881. E. Milner, Warrington, Lancashire, "Improvements in the method of producing white pigments from lead."

1886. J. Thomas, Middlesbrough, Yorkshire, "Improvements in furnaces for generating gas and melting metals."—Dated June 22, 1872.

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Prof. Henry Morton, Hugo Tamm, R. W. Higgs, A. B. MacDowall, W. L. Carpenter, J. W. Mallet, are thanked for their communications.

BOOKS RECEIVED.

Chemistry, Inorganic and Organic, with Experiments. By Charles Loudon Bloxam. Second Edition. J. and A. Churchill.

Cooley's Cyclopœdia of Practical Receipts. Fifth Edition. Revised and partly Re-written by Richard V. Tuson, F.C.S. J. and A. Churchill.

Qualitative Chemical Analysis. By Dr. C. Remigius Fresenius. Eighth Edition. Translated by A. Vacher. J. and A. Churchill.

Sewer Gas, and How to Keep it out of Houses. By Osborne Reynolds, M.A. Macmillan and Co.

Monthly Review of Dental Surgery, Vol. I.

The Hygiene of Air and Water. By W. Procter, M.D., F.C.S. R. Hardwicke.

Canada Medical and Surgical Journal.

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THE CHEMICAL NEWS.

Vol. XXVI. No. 665.

ON THE FUSION OF METALLIC ARSENIC.*

By J. W. MALLET, Ph.D., M.D.,
Professor of Pure and Applied Chemistry, University of Virginia.

Experiments on this subject, made by Mr. Dunnington and Mr. Adger, students in the Laboratory of the University of Virginia, under the author's directions, were described. These experiments had been undertaken in view of the generally repeated statement that arsenic cannot be fused, but passes directly from the solid into the vaporous state, and that an attempt to secure increased pressure by using a sealed tube only results in bursting the tube. The statement by Landolt† (given apparently without further details) that, by using a glass tube enclosed in one of iron, the metal heated for some time to low redness under pressure may be melted into globules, was noticed only after the experiments to be mentioned had been made.

Arsenic, in the form of small fragments and coarse powder, was placed in a thick barometer-tube of soft glass and of small bore, well sealed at both ends and enclosed in a piece of wrought-iron gas-tubing closed at each end by an iron screw cap; the space between the two tubes was filled with sand well shaken down, and the whole was heated to redness by a charcoal fire. Another similar iron tube placed beside the former served to contain several little glass tubes with samples of different metals whose fusion might afford some indication of the temperature at which that of the arsenic occurred.

Arsenic thus treated was found, on cooling, to have fused into a perfectly compact crystalline mass, moulded to the shape of the tube, of steel-grey colour and brilliant lustre, of sp. gr. = 5·709 at 19° C. It possessed a considerable degree of cohesive strengh as compared with common sublimed arsenic, and even seemed to exhibit faint traces of flattening before crushing under the hammer. It gradually tarnished on exposure to the air, and presented all the chemical properties of ordinary crystalline arsenic obtained by sublimation. The temperature required for fusion lies between the melting-points of antimony and silver.

The glass tube used was found greatly distended by the tension of the vapour, and the siliceous sand, even when of the purest kind (from Fontainebleau), and previously well washed with hydrochloric acid, and then with water, was cemented together (in a way very interesting in connection with the history of metamorphism) into a kind of artificial sandstone. Specimens of fused and semi-fused arsenic, and of the tubes surrounded by a thick crust of compacted sand, were exhibited to the Section.

ON A MODIFICATION OF HOFMANN'S APPARATUS FOR ELECTROLYSIS OF WATER.*

By C. J. WOODWARD, B.Sc.

The extremely convenient arrangement of Dr. Hofmann for showing the composition of water by electrolysis is, owing to its first cost and delicate construction, only accessible to those who are able to make a considerable expenditure in apparatus. The modification I have used in my class lectures is in every way as serviceable, and has the advantage of being fitted up at a small cost. The arrangement is as follows:—A glass cylindrical vessel, about 5 centimetres diameter and about 6 centimetres high, has ground into it a stopper in which are three holes, each hole being about 15 m.m. diameter. In two of these holes are fitted the tubes intended for the reception of the gases, oxygen and hydrogen, whilst the remaining hole serves to insert a third tube to contain the acid expelled as the gases are formed. The tubes for collecting the gases have electrodes made by cutting strips of platinum foil, which are cemented lengthwise on the tube and hang a centimetre or so down below the edges of the tubes. Pieces of caoutchouc tube are used to make the tubes acid-tight, and to make the apparatus firm a triangular cork wedge is placed within the tubes. Instead of glass cocks, as in the arrangement of Hofmann, pinch-cocks are used, as I found these much more manageable, besides being cheaper. The apparatus, when charged with dilute acid of 1 to 4, will give off about 15 c.c. of gases per minute when four pint cells of Grove's battery are used.

* Read before the British Association, Brighton Meeting, Section B.
† *Verhandl. d. niederrhein. Gesellschaft*, August 4, 1859, quoted in Will's *Jahresbericht* for 1859, S. 182.

ON THE DUST THROWN UP BY VESUVIUS IN THE RECENT ERUPTION.*

By GEORGE GLADSTONE, F.C.S.

During the eruption of Vesuvius which took place last spring, Naples and the surrounding country was visited by a shower of fine black dust. In some places the fall was very heavy, and even in Ischia, at twenty-five miles distance from the mountain, where the dust examined was collected, the quantity was sufficient to cause great annoyance to the inhabitants. It consisted of aggregations of crystallised quartz, dotted over with the magnetic oxide of iron. This ferroso-ferric oxide was also crystalline, and possessed a high metallic lustre. The grains were very uniform in size, and would pass through a wire gauge the apertures of which measured the 16,000th part of a square inch. By boiling the sand in hydrochloric acid, the whole of the iron is removed, and nothing but crystals of pure white quartz remained. Its composition is the same as that of the iron sand which is found in the soil in some parts of the country round Vesuvius, and which is the product of former eruptions; the latter, however, contains a larger relative proportion of iron, and the grains show a water-worn appearance under the microscope. Neither of the Vesuvian specimens contain titanium, which is found in the magnetic iron sand of New Zealand, which has most likely been ejected from the great volcano of Mount Egmont.

PRELIMINARY NOTE ON "GUARANINE."*

By JOHN WILLIAMS, F.C.S.

The fruit of the *Paulina Sorbilis* is made up into rolls by the Indians of Para, in South America, and is by them called "Guarana." Its infusion is used as a beverage, and within a few months has been introduced into medical practice, and recommended as a remedy for sick headache.

Dr. Stenhouse some years back examined guarana, and isolated the crystallisable principle, which he named guaranine, but considered it to be identical with caffeine or theine.

I considered it a matter of interest to prepare some of this substance, and first proceeded to do so by the process given by Stenhouse, but found it troublesome, and the

* Read before the British Association, Brighton Meeting, Section B.

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result not so satisfactory as might be desired. This led me to adopt the following process, which I found in every way satisfactory.

Guarana reduced to a fine powder, is mixed with one-third of its weight of hydrate of lime, and moistened with water. After an hour or two it is placed in a drying closet, and completely dried at a moderate heat. This is exhausted with boiling benzole, filtered, and the benzole distilled off, when a small quantity of light-coloured oily matter is left. This is treated with boiling water, and the whole digested over the water-bath until all traces of benzole have been dissipated, then filtered through a wetted filter so as to keep back the oil; the aqueous portion evaporated to a small bulk, and set on one side for 24 hours, yields the guaranine white and pure, in fact requiring no furthur purification of any kind. I have tried the process upon tea, and it appears to answer, but have not yet finished my experiments in that direction. As far as appearance goes, guaranine appears to be identical with theine and caffeine, but the author suspects it will be found to be rather more soluble in water, and not quite so bitter in taste as the above mentioned bodies.

ON THE OXIDATING POWER OF IODATE OF POTASSIUM.

By E. SONSTADT.

I. *In the Dry Way.*

About a year ago I found a mineral, subsequently traced to the lime brought from Castletown, which closely resembled anthracite in appearance, but could not be scratched with a knife. Its hardness, in the best specimens, was about 6·5. The specific gravity of a piece that had evidently been heated with the lime among which it was found was 1·689. A specimen picked up in a street in Castletown, which did not appear to have been in the fire, had sp. gr. 1·3852. A splinter of the mineral heated before the blowpipe appeared to be unaffected, while splinters of anthracite and of gas-retort carbon similarly heated were burnt without difficulty. The finely-powdered and levigated mineral was scarcely attacked by nitre at a red heat—while fragments of anthracite and of gas-retort carbon were deflagrated in the same crucible, the powder remaining intact even after the intense heat thus produced. The powder was fused with caustic soda; and with chlorate of potassium with like apparently negative result; although always in these experiments the mineral lost in weight. A portion heated with carbonate of sodium for several hours in a forge-fire was found to have lost about half its weight, but I could detect only traces of substances in the alkaline solution. Digested for several days with strong acids, only traces of matter were dissolved. Heating with acid chromate of potassium and sulphuric acid was likewise resultless; but when the powder, or even fragments of the mineral, were mixed with iodate of potassium, and heated in a glass tube, deflagration ensued, and a gas (unaccompanied by iodine when the purest specimens were used) was given off, which gave, when conducted into an ammoniacal solution of chloride of barium, a white precipitate, which dissolved in acids with evolution of an inodorous gas, capable of extinguishing flame. The substance is, therefore, carbon. The mineral is not absolutely unattacked by the processes that have been described. Its behaviour before the blowpipe is precisely that of the diamond, which in small fragments may, as well as this mineral, be thus burnt, though very slowly. But I think that this mineral is quite as difficult of oxidation as the diamond, which latter, however, I have (many years ago) only examined in very small fragments before the blowpipe. From the similarity of the behaviour of the two minerals when heated in the blowpipe-flame, it may be supposed that diamond-powder would, like the black *mineral, deflagrate* when heated with iodate of potassium. Many specimens of this mineral show ligneous structure quite plainly—some even look like wood turned black. There is a great difference in the purity of the specimens, most of which are more or less clogged in pores with lime introduced in the kiln. The aqua regia with which, in one experiment, several grammes of the finely-powdered mineral were heated for two or three days was found to have taken up traces of silica, alumina, lime, magnesia, lithium, sodium, and potassium. The merest traces, however, of the first four of these substances could be detected in the residue left on deflagrating purer specimens of the mineral with iodate of potassium. I have not had an opportunity of finding out whether this mineral belongs to the limestone of Castletown, or to the coal with which the limestone is burnt. By workers with the lime, the mineral was explained to me to be coal that had escaped burning. If this mineral, as little combustible as the diamond, nearly as hard as quartz, and having a higher specific gravity than anthracite, should be regarded by mineralogists as a distinct variety of carbon, then *tetratomic* carbon will have been recognised in *four* varieties or allotropic conditions. I believe that no monatomic substance is known to have any allotropic modification, whereas several polyatomic elements, as sulphur, phosphorus, selenium, boron, and antimony, are known to have such modifications.

A few experiments upon the action of melted iodate of potassium upon some minerals, particularly sulphides, have been made; but the results are as yet too incomplete to be worth communicating. Probably the reason of the great power of iodate of potassium as an oxidating agent in the dry way, as compared with chlorates and nitrates, is because it acquires a sensibly higher temperature than chlorate of potassium before it decomposes, and when it does get hot enough to decompose, the oxygen it gives off is pure and in abundance; whereas nitrates under like heating, or at a much higher temperature, give off mixed gases.

II. *In the Wet Way.*

After discovering the presence of iodate of calcium in sea-water, and getting a clue, by some preliminary experiments, to the important function it performs there, it seemed desirable to trace carefully, by experiments, the limits of the oxidating power of iodic acid in a neutral or alkaline liquid—first, upon oxidisable inorganic compounds; and, secondly, upon some definite (so-called) organic substances and upon putrescible matter. Thus far, all my experiments greatly strengthen the views expressed in my papers on "The Presence of Iodate of Calcium in Sea-Water," and confirm the statement that a minute proportion of an iodate in a neutral or alkaline liquid containing much putrescible matter has, practically, unlimited power in preventing putrescence, and in arresting its progress when begun, by transformations which render innocuous as air-poisoners the foulest smelling substances. As has already been explained, the peculiarity of the agent lies in its power of continually reproducing itself after it has undergone reduction. Long known reactions suffice, in a general way, to account for these phenomena. That some iodides, and notably those of calcium and of barium, are decomposed when their solutions are exposed to the air, with formation of carbonates and separation of iodine, is a familiar fact. That such solutions, if containing also strong bases in excess, should under like circumstances have an iodate formed in them instead of free iodine, is only a widening of statements that have remained unchallenged for years; such as, that iodide of potassium containing free alkali or alkaline carbonate absorbs carbonic acid from the air; and that the formation of a carbonate is accompanied in this instance by the formation of an iodate. These reactions go on slowly; but their progress may be made sensible in a few hours by, for example, passing carbonic acid gas to saturation through a solution of an alkaline iodide, to which some chloride of barium or of calcium, and a little alkaline carbonate, have

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been added. Traces of an iodate are formed; and on exposing the liquid in an open dish to the air, the proportion of iodate increases, so that in a day or two it may be quite easily recognised. My experiments teach that carbonic acid is not capable of effecting this change without the presence of atmospheric oxygen; for I find that, in a close vessel charged with carbonic acid, the trace of iodate at first formed (which does not afterwards increase in quantity by further passage of carbonic acid gas) is not apparently greater than the oxygen originally contained in the air dissolved in the liquid might be supposed able to account for. But such a liquid, exposed to air, goes on forming an iodate continuously. I have more to communicate on this subject that would be out of place here, and which I keep for another time. At present, I desire only to point out that the formation of an iodate under atmospheric conditions has been noticed before me, and that an experimental confirmation of the natural formation of an iodate in such manner is very easy to be obtained. I have always found the washings of the ash of sea-weed to contain an iodate after long exposure; and this formation of iodate, if neglected, might lead to considerable loss, since sparingly soluble iodate of calcium remains with the residue after lixiviation. Ordinarily, however, kelp contains sulphides, and until these are oxidated to thiosulphates no iodate is produced. And now we come to the consideration of the reactions in the wet way between

Iodates and Thiosulphates.

There is, I believe, an impression prevalent that the alkaline thiosulphates undergo oxidation by exposure to air in solution, or by long keeping, with access of air, in a moist state. I have found, however, that long keeping increases the purity of thiosulphates, owing to the oxidation of sulphides, or, possibly, of other oxides of sulphur than thiosulphuric acid. Some thiosulphate of sodium that I had by me for ten years in a loosely-stoppered bottle, often exposed to moist air, contained after that time no sulphate. It had become very pure, as has been described. A recognition of the great stability of the thiosulphates is of importance in connection with what follows.

Solutions of pure iodates and thiosulphates, mixed in any proportion in strong or in dilute solutions, with or without access of air, in sunlight or in shade, undergo no change. Some of the experiments extended over about three months, but in no case could I detect the slightest indication of any chemical action having taken place. The mixed solutions remain neutral, and the iodic acid may be fractionally separated from the thiosulphuric acid by precipitation of the highly diluted liquid by a soluble barium salt. No sulphate is formed; but the addition of an acid in small proportion to the mixed solution turns it strongly alkaline. Further addition of acid precipitates iodine after the neutral point is passed, if the iodate is present in excess, and in such case, if hydrochloric acid is used, sulphuric acid is formed. If the proportion of iodate to thiosulphate is that of one atom, or less, of the former to six of the latter, the liquid remains perfectly colourless and limpid on addition of excess of acid, and the only products are water, a tetrathionate, an iodide, and a salt of the acid used. Carbonic acid gives no reaction. With hydrochloric acid, the formula, determined by several closely-agreeing experiments, is—

$$(1).\ 6Na_2S_2O_3+KIO_3+6HCl=$$
$$=3Na_2S_4O_6+KI+6NaCl+3H_2O.$$

Iodates and thiosulphates may, therefore, both exist together in solution, and yet in the ordinary course of analysis both escape observation. The fact that they do actually exist together in solution very commonly has just been referred to.

When citric acid is used, instead of hydrochloric acid, to acidify the mixed solutions of iodate and thiosulphate, the solution becomes neutral to test-paper, sensibly before iodine is set free, in the solution containing a trace of iodate in excess. The equation representing the reaction up to the point of neutrality to litmus-paper is—

$$(2).\ 6Na_2S_2O_3+KIO_3+2C_6H_8O_7=$$
$$=3Na_2S_4O_6+KI+2C_6H_5Na_3O_7+3H_2O.$$

This reaction seems to indicate that trimetallic sodium citrate is not really neutral, as usually stated, but has an alkaline character; since, to get an iodine reaction (a trace of iodate in excess being used), a quarter atom of citric acid, in addition to the two atoms already used, had to be added, which gives, after multiplying the equation into four for avoidance of fractional coefficients—

$$(3).\ 24Na_2S_2O_3+4KIO_3+9C_6H_8O_7=$$
$$=12Na_2S_4O_6+4KI+9C_6Na_2\tfrac{1}{2}H_5\tfrac{1}{2}O_7+12H_2O.$$

This reaction implies exact *chemical neutrality*; and here we have exactly one-third of the hydrogen atom belonging to the citric acid displaced by sodium atoms; or, the number of atoms of the latter to those of the former is as 1 : 2.

With tartaric acid, the liquid becomes neutral to litmus-paper when the proportions used are—

$$(4).\ 6Na_2S_2O_3+KIO_3+2C_4H_6O_6=$$
$$=3Na_2S_4O_6+KI+2C_4Na_3H_3O_6+3H_2O,$$

a formula entirely correspondent to that already found (2) under identical conditions for citric acid, notwithstanding that citric acid is considered a triatomic, and tartaric a tetratomic acid. The addition of one more atom of tartaric acid to the liquid exactly gives the iodine reaction, a trace of iodate in excess being present as before.

$$(5).\ 6Na_2S_2O_3+KIO_3+3C_4H_6O_6=$$
$$=3Na_2S_4O_6+KI+3C_4Na_2H_4O_6+3H_2O,$$

an equation also corresponding in significance to that found for citric acid (3), the number of sodium atoms being to the number of hydrogen atoms as 1 : 2; only here this proportion does not show as remarkable, because the tartrate formed has the composition of an ordinary neutral tartrate, which salt is, therefore (unlike so-called "neutral" citrates), really chemically neutral.

This mode of investigating the constitution of acids and their salts is evidently capable of being extended to a very large class, and suggests a ready, as well as most accurate, volumetric method of estimating many acids—tartaric and phosphoric acids, for instance. As a preliminary experiment in this direction, I put, to a weighed portion of pure acid tartrate of potassium, about its own bulk of sulphate of calcium and chloride of potassium moistened with dilute sulphuric acid, added water, supersaturated with carbonate of sodium, and evaporated, with addition of hydrochloric acid in excess, to dryness on the water-bath until acid odour ceased to be given off. The residue was treated with a properly adjusted solution of iodate of potassium and thiosulphate of sodium until a slight permanent colour reaction was obtained, and then just caused to disappear. The quantity of reagent that had been used was ascertained by weighing the flask containing it before and after testing, and this quantity was found to agree, within the limits of gravimetrical errors, with the quantity of the reagent which corresponded exactly with all the tartaric acid contained in the weighed quantity taken of acid tartrate. Hence, although tartaric acid precipitates an acid tartrate from neutral solution of sulphate or chloride of potassium, yet when a tartrate is evaporated to dryness with hydrochloric acid in excess, under the conditions described, the whole of the tartaric acid is set free and admits of easy and accurate estimation.

From what precedes, it may easily be perceived that, in the mixed solutions of an iodate and a thiosulphate, we have an instrument of great delicacy and facility of application for the determination of the relations existing between the atomic weights of several elements. With a trace of iodate in excess, it matters not whether the acid added to give the reaction be added in large or in ponderably inappreciable excess. In either case, the reaction is quite sharp and definitely fixed. If, for instance, such a liquid were formed

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with accurately weighed portions of iodate of potassium and thiosulphate of sodium, adjusted to give with sulphuric acid a faint iodine reaction, then the substitution of an exactly equivalent proportion of iodate of sodium, say, for the potassium salt, would be indicated by the same reaction; and an imponderable excess or deficiency of the sodium salt might be estimated by a volumetric determination of the iodine set free—a sufficient excess of iodate in such case being used in both experiments to allow a margin for errors in weighing. It is not even necessary that the thiosulphate should be pure. Commercial "hyposulphite of soda" in solution becomes opalescent from precipitated sulphur when an iodate is dissolved in it; but, with a very slight excess of iodate, the liquid clears itself after a day or two, and becomes fit for use. For ascertaining the atomic weights of acids, referred to a pure iodate as a standard, the method is equally applicable.

Evidently, all acids capable of acting at all should produce precisely the same effect (provided they are not capable of acting chemically upon pure solutions of iodides or iodates) upon portions of the same solution of iodate and thiosulphate, *if the atomic weights of the elements are invariable in whatever juxtaposition they may be placed.* But if the elements can, whether according to their densities, degrees of affinity, or other conditions, include in close embrace proportions of one another more or less modified by such conditions, then this method ought to show such to be the case, even although such modifications were within a range far too narrow for certain detection by gravimetrical processes. Of course the atomic weight of the acid used to produce the reaction does not influence the result, since, whatever acid is taken is supposed, in the kind of experiment now being considered, to be used in excess. But if, for instance, the weight of potassium in an atom of sulphate of potassium is not absolutely identical with the weight of potassium in an atom of, say, acetate of potassium, such a difference must necessarily be made evident by the necessity for a different adjustment of the proportions of iodate to thiosulphate in the test-liquor, in the cases, respectively, of acidulating by sulphuric or by acetic acid. And, in fact, *just such differences do exist.* A liquid that shall give a distinct colouration with sulphuric acid shall remain absolutely colourless with excess of some other acids (acetic acid of the number); and these also diverge, although by exceedingly small differences; so that I do not think the entire swing between the extremes of these differences that I have observed is sufficient in amount to have admitted of its certain discovery by preceding methods of investigation. Such differences, if found at all, would be referred by general opinion, if not by the experimenter himself, to impurities in the substances experimented upon, or to errors of weighing, or other sources of error which appear to be in part minimised, and in part excluded in the instance before us, by the very nature of the process. Indeed, a nicely adjusted solution of iodate and thiosulphate is itself a balance of nature's own providing; the colour reaction being the passage of the index just past zero, or the point at which the iodate is exactly reduced to iodide. And since, whatever proportion of iodate is in excess, must, on acidulating, occasion the precipitation of six proportionals of iodine, such passage of the index past zero is indicated with great nicety.

In conclusion, some reference should be made to the well-known reaction for the production of tetrathionates ($2Na_2S_2O_3+2I=Na_2S_4O_6+2NaI$), which lies at the root of the reaction I have been describing. In the text-books, it is usually directed, in the preparation of tetrathionates, to filter off the precipitated sulphur. But, according to the equations given, no sulphur ought to separate. To examine this, I prepared some chemically pure iodine according to the process devised by Stas, and given by him in his papers on the atomic weights of some elements. *This iodine*, added to solution of thiosulphate of sodium, dissolved to a perfectly limpid solution, nor, when added in excess, did it separate any sulphur. I name this chiefly because it suggests a convenient test for the impurity of iodine. Iodine which precipitates sulphur from solution of pure thiosulphate of sodium is certainly impure; but I am not prepared, on the other hand, to say that iodine which does not precipitate sulphur from such a solution is necessarily free from all kinds of impurity, although such non-precipitation of sulphur would certainly look well.

PROCESSES FOR DISTINGUISHING AND SEPARATING SILK, WOOL, AND VEGETABLE FIBRES IN MIXED TISSUES.

By EMILE KOPP.

The processes generally employed depend either upon the manner in which animal and vegetable fibres behave with certain reagents, or upon their greater or less affinity for different colouring materials, especially artificial colouring matters. In order better to appreciate the value of the processes indicated, it will be well to recall the principal reactions presented by textile fibres.

Vegetable fibres, (cotton, linen, hemp, &c.) all having cellulose for a base, resist very energetically the action even of boiling aqueous solutions of the caustic alkalies, but they are strongly attacked by concentrated acids, (sulphuric, nitric, and hydrochloric) and even by these acids considerably diluted with water, when acted upon by heat. Thus it is possible to immerse a cotton tissue without great injury, in cold water containing in 100 parts 5 to 10 parts of acid; but if the solution is heated, especially if it is boiled, the cotton soon becomes friable, then dissolves, and is transformed successively into gum and sugar. It is to be observed, however, that fuming nitric acid, or a mixture of nitric and sulphuric acids, does not dissolve vegetable fibre, but transforms it, almost without changing its physical aspect, into gun-cotton or pyroxylin. Ammonia is absolutely without action on cotton or hemp, either in the heat or cold; but if a solution is made of hydrated oxide of copper in ammonia (Schweitzer's blue liquor) which is a solution of the oxide of cupr. ammonium [$(NH_3)_4Cu$] cotton, hemp, and finally linen, are dissolved by it. Vegetable fibres, when pure, have ordinarily little affinity for artificial colouring matters, and are only coloured very faintly or not at all by such dyes. A slight application of soap is sufficient to remove the colouration. Cellulose also resists tolerably the action of chlorine, and hypochlorites, and has no characteristic odour when burned.

Wool, unlike cotton, resists pretty well the action of acid solutions, even when rather strong and warm; but caustic lyes destroy its state of aggregation and dissolve it, particularly when hot. As wool contains sulphur, its solution in caustic soda gives rise to sulphide of sodium which blackens acetate of lead. Nitric acid colours wool an intense yellow; chlorine and the hypochlorites also alter it, giving it a like yellow. Schweitzer's reagent is without action in the cold, but in presence of heat the wool is dissolved. In the decomposition of wool by heat it gives off the characteristic odour of burnt horn. Wool presents a remarkable affinity for colouring materials in general, and especially for artificial colours, which dye it with the greatest facility even without the aid of mordants. Silk gives in burning a similar odour to that of wool. It is dissolved by the strong concentrated acids, particularly when hot. Cold nitric acid colours it yellow. Acids diluted with water have not a very vigorous action. Concentrated alkalies dissolve silk as they do wool, but the solution does not contain sulphide of sodium. The alkalies, much diluted with water alter, but do not dissolve it; ammonia has no action on it, but Schweitzer's solution liquefies it, as it does cotton. Silk resembles wool in its affinities for colouring matters.

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Let us now examine successively the processes which may be used, first, to recognise the different kinds of textile fibres in mixed tissues, and second, to separate them so that one or the other of these may be used again; omitting all unessential details. We will here speak only of purely chemical reactions, remembering, however, that the microscope is of valuable aid in identifying textile fibres. These, according to their origin, present textures wholly distinct, which by themselves are sufficient to characterise the different species,

To recognise the presence of Vegetable Fibre (Cotton, Hemp, Linen, Jute, &c.) in a tissue of Wool and Silk, it is only necessary to boil the fabric in an aqueous solution of caustic soda (100 parts of water to 10 parts of fused caustic soda). The wool and silk are dissolved, but the vegetable fibre is not attacked, and remains as a residue retaining its essential characteristics. To better distinguish it in case it has been coloured, the whole is thrown on a little calico filter, and washed with hot water. The washed fibre is then laid out in tepid water acidulated with about 5 parts in 100 of hydrochloric acid. After 10 minutes, a little chlorine water or a few drops of solution of chloride of lime is added, either of which bleaches vegetable fibres. The filtrate of the caustic soda solution which holds the wool or silk, may be tested immediately for wool. If this latter is present, sulphide of sodium is formed, which remains in the solution; its presence may be detected by adding 2 or 3 drops of acetate of lead. If a white precipitate is formed, which redissolves completely upon agitation, the tissue must have been of silk simply; but if, on the contrary, there appears a permanent black precipitate of sulphide of lead, it contained wool. For acetate of lead, a few drops of solution of nitroprusside of sodium may be substituted, which gives a beautiful violet colour, in presence of sulphide of sodium.

When the fabric is strongly charged with colouring matter, it may be advantageous to operate in the following manner. A mixture is prepared of 2 volumes of sulphuric acid, concentrated to 66°, and of 1 volume of equally strong and fuming nitric acid. After the mixture has cooled, the tissue, cut into small pieces, is immersed, and allowed to remain for 15 or 20 minutes, with agitation from time to time. The wool, silk, and colouring materials are oxidised and destroyed, but the vegetable fibre is transformed into gun-cotton or insoluble pyroxylin retaining its characteristic fibre. The whole is thrown into a large quantity of water, where the gun-cotton is deposited. The fluid is decanted and the residue collected upon a filter, thoroughly washed and dried. The dried residue then presents fulminating properties very characteristic of gun-cotton. For mixed fabrics which are white or not too deeply coloured, recourse is had to the affinity of animal fibres for artificial colouring agents. A tissue dyed in deep colours should be previously decolourised by immersion in weak chlorine water, and a subsequent thorough washing with boiling water. There are, however some precautions to be observed, since cotton is also capable of being dyed in baths of aniline colours, especially if it is impregnated with feculent substances, and others which enter into the composition of the preparations.* The preparation must therefore be removed. This is effected by boiling the tissue 10 minutes in water containing in 100 parts 2 parts of carbonate of soda and a little soap, rinsing in hot water, and then immersing for 5 or 10 minutes in water at 50° to 60°, holding 2 parts in 100 of hydrochloric or sulphuric acid, and finally washing thoroughly. The colouring-bath is in the mean time prepared in the following manner:—(we will choose for example, red aniline or fuchsine.) A few decigrammes of fuchsine are dissolved in 25 or 30 c.c. of water, the solution boiled, and during ebullition, caustic soda is added drop by drop, until it presents only a light rose tint. It is then removed from the fire, and the tissue put into the liquor. After a few minutes it is taken out, well washed with pure water and dried. The threads of silk and wool are then found to be dyed a beautiful vivid red, while the vegetable threads, cotton, flax, &c., remain entirely uncoloured.

To recognise the presence of Wool in Silk, and vice versa.—If the tissues are white or slightly coloured, the presence of sulphur in the wool may be made use of. A solution of oxide of lead in caustic soda is first prepared by boiling litharge in the latter, allowing it to settle and decanting the clear liquor. In this is placed the tissue. The threads of wool which contain sulphur, naturally become immediately black, owing to the formation of black sulphide of lead; while the silk threads which are without sulphur, do not change their shade. Professor Stefanelli, of Florence, has advised the use of Schweitzer's liquor; that is to say, the solution of hydrated oxide of copper in ammonia. He works as follows. A piece 2 centimetres square of the tissue to be examined is put into 10 or 12 c.c. of the blue copper liquor. At the end of 5 or 6 minutes the silk is dissolved, while the wool is not in the least attacked. If the silk should be dyed black, it is necessary to take a double volume of the liquor and prolong the contact to 10 or 12 minutes. After removing the wool the blue liquor quickly supersaturated with nitric acid does not give a sensible precipitate. But if a vegetable fibre should be present, which is generally dissolved, although much more slowly by Schweitzer's liquor, this, upon saturation with nitric acid, will give a precipitate of cellulose, under the form of white or light-coloured flocks. A more simple process consists in employing concentrated acids. Ordinary nitric acid dissolves silk in the cold, without sensibly attacking wool. It is the same with cold sulphuric acid when sufficiently concentrated. This acid at the same time clears the wool of vegetable fibres, which become transformed under these circumstances into gummy matters or sugars. But it appears preferable to employ concentrated hydrochloric acid, used cold, immersing the tissue in the acid. In a short time the silk is completely dissolved, the wool and vegetable fibres remaining unaltered. Water is added and fibres not attacked (consisting of wool and those of vegetable origin) are collected upon a filter where they are perfectly washed. Generally they are then to be decolourised. To identify them recourse may be had either to the action of boiling caustic soda-lye, which dissolves only the wool, or to artificial colouring matters, fuchsine, aniline violet, or nitropicric acid, which do not colour cotton,* if one works with proper precautions. In all these trials it is always well previously to clear the tissues to be examined of their preparations† and colouring matters; the former by successive treatment with boiling water, either pure or slightly acidulated, or rendered alkaline by a little carbonate of soda; and the latter by chlorine water, &c., finishing always with a thorough rinsing in pure warm water, after which the tissue is dried.

Industrial Separation of Animal and Vegetable Fibres.—The utilisation of rags has given birth long since to important industries. Cotton, linen, and hemp rags, old ropes, &c., are the foundation for the manufacture of paper. Pure woollen rags serve for the preparation of worked-over wool (shoddy) which spun with new, enters into the manufacture of a number of woollen tissues. We will here especially consider rags of mixed wool and cotton, which it is convenient to class in two divisions.

1. Rags in which vegetable fibre mostly predominates, and which are suitable for the manufacture of paper.

2. Rags containing so much wool that it is advantageous to destroy the vegetable fibre, in order to separate the former and render it fit for use.

I. In well-organised paper-mills the wool, in rags containing but a small quantity of it, is separated as exactly as possible by mechanical means, and the remainder of the tissue reserved. If a little wool still stays with the

* French "apprets," English equivalent, "stiffening," or sizing.

* French, "qui ne teignent pas la *laine*;" *le coton* is evidently meant, as it is asserted on a preceding page, "La laine présente une très-grand affinité pour les matières colorantes en général, et surtout pour les couleurs artificielles."

† Apprets.

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rags of vegetable fibre, it ordinarily disappears completely in the operation of cleansing and bleaching, especially during the boiling in closed vessels with quick-lime or caustic soda, to which hemp, linen, or cotton rags are submitted before passing to the chlorine or being treated by the unravelling machines. It frequently happens that after picking the mixed rags, there remains refuse containing a sufficient quantity of wool, but of such bad quality that it cannot be utilised as a textile fibre. If it is desired to treat these rags with caustic soda-lye with a view to dissolving the wool and isolating the vegetable fibre, the final product applicable to paper-making, it is not worth while to go to this expense to accomplish it. In such cases the process employed is that of Mr. Ward. It consists in submitting these rags to the action of vapour of water under a pressure of from 3 to 5 atmospheres. At this temperature under the influence of superheated steam, the wool is converted into a blackish substance, friable, and easily separated mechanically in the state of a dry powder, leaving the vegetable fibre intact, and suitable for the preparation of paper-pulp. The powder of altered wool contains still all its original elements, and constitutes an excellent manure; indeed, it contains 73 parts in 100 of organic matter, and 10 to 12 parts in 100 of nitrogen, corresponding to 12 to 14 in 100 of ammonia.

II. Mixed rags, rich in wool, still of tolerable quality, are submitted to processes designed to destroy the vegetable fibre. The method most generally followed consists in well impregnating with water, containing 5 to 10 parts in 100 of sulphuric or hydrochloric acid. They are left to drip, pressed slightly, and then laid out upon the floor of a desiccator, the temperature of which is raised gradually towards 90 to 100°. They remain here during several hours according as they are thicker or thinner. Owing to the evaporarion of the water, the acid is concentrated in the rags, and with the aid of heat it reacts upon the vegetable fibre, transforming the cellulose into gummy matters and sugars. After this, the vegetable fibre becomes very friable, and may then be separated mechanically from the wool, which has preserved its textile qualities. But this process needs to be managed with much precaution, and to be well watched, because under the influence of acids and an elevated temperature the wool may be altered, losing its sweetness, and also the property of felting with facility. Some makers, for this reason, work as described below. Instead of exposing the dry rags to an elevated temperature, they dry them at a gentle heat, 40 to 50°, then submit them to steaming (that is to a current of dry steam*) and afterwards dry them once more. The vegetable fibre is thus rendered friable and pulverulent. With mixed rags of very good quality, solutions of oxalic acid are sometimes substituted, or hydrochlorate of albumen for sulphuric or hydrochloric acid; these substances destroy the vegetable fibres without sensibly attacking the wool.

Instead of the drying operation, the mixed rags may be treated in the moist way. This is Seloup's process. In this process a bath of hydrochloric acid diluted with three or times its volume of water is prepared in a wooden vat. By means of a jet of steam the bath is warmed to about 90°, and at the same time the rags are immersed in it. The jet of steam is arrested when the bath appears upon the point of boiling. At the end of from 30 to 50 minutes, the vegetable fibre is dissolved. The rags are then removed, allowed to drain into the bath (which may be used several times,) and finally wrung out. They are next washed with water until free from acid; but it is preferable to throw them, still slightly acid, into a solution of carbonate of soda, and to stir vigorously. The soda saturates the acid, and at the same time liberates carbonic acid, which, escaping through the woollen fibres rises and swells them, separating them one from the other. The quantity of carbonate of soda should be just sufficient to neutralise the acid. The wool is afterwards washed thoroughly with running water. In order to render it sweet, it is then passed through a tepid soap-bath, which is followed by another washing, when it is at last dried at a gentle heat.

The English process of Mr. Stuart, rests upon the fact that wool impregnated with a salt of alumina, is not subject to loss of its qualities under the influence of hydrochloric acid and an elevated temperature. 50 kilogrms. of sulphate of alumina of commerce ($Al_2O_3,3SO_3+18aq.$) and 25 kilogrms. of common salt, are dissolved in 450 litres of water. The rags are impregnated with this solution, allowed to drain, squeezed out slightly, and dried. They are then exposed during several hours to a temperature of 90° C., when the sulphate of alumina forms, by double decomposition with common salt, sulphate of soda, and chloride of aluminum. This last is decomposed in turn, alumina and hydrochloric acid being formed under the influence of heat (a certain quantity of bisulphate of soda is formed at the same time) the latter substance attacking the vegetable fibres. These become very friable, and may afterwards be separated mechanically in the form of dust. For strong and thick rags, a much more concentrated solution is employed, containing in 450 litres of water, 75 kilogrms. of sulphate of alumina, and 40 kilogrms. common salt. Instead of squeezing out and afterwards heating to dryness the impregnated rags, they may be boiled in the solution, or steamed by a jet of moist steam so that the vegetable fibres will become friable or even soluble in water. Another Englishman, Mr. Rowley, treats the mixed rags with weak sulphuric acid, permits them to drain, presses out the excess of acid liquor, and dries them by a current of warm air in a sieve of wire-gauze* kept constantly in motion by machinery. They are then put into heated sand, where they are manipulated until, by friction against the grains, all the cotton has been pulverised and detached. The separation of the sand from the fibre of wool, which in this process is more or less protracted, is finally accomplished very easily by mechanical means. This process gives good results and is inexpensive. We think that the most rational and economical means consists in employing a bath of sulphuric or hydrochloric acid, containing 300 to 500 parts of water to 100 of acid. The rags are left to drain, aired or pressed out a little, and dried slowly, the temperature of the stove or of the current of dry air being gradually raised to 70°, or in certain cases even to 90°. This temperature should be maintained through several hours, and the more as the vegetable fibre is tougher or harder to destroy. If it is wished to really guarantee the wool, it will be well to use a mordant† of alumina, which is made quite simply by adding to 100 parts of an acid bath, 1 to 2 parts of sulphate of alumina of commerce ($Al_2O_3,3SO_3+18aq$), or even of ordinary alum.—*Moniteur Scientifique.*

* "Au vaporisage, c'est-à-dire à un courant de vapeur plutot sec *que humide.*"

* "Toile métallique."
† "La mordancer en alumine."

ON THE

EVIL EFFECTS OF THE USE OF ARSENIC IN CERTAIN GREEN COLOURS.‡

By FRANK W. DRAPER, M.D.

(Concluded from p. 92).

Who are the victims of the unnecessary, yet too common, practice of covering the walls of rooms with poisonous paper? It is obvious that everybody exposed to the influence in question is not affected, even to a moderate degree. No positive criterion can be established, indeed, since the conditions of exposure are so varied and complicated. It cannot be said of a sample of wall-paper with a stated amount of arsenic on its surface, that when laid on the wall of a room it will produce a regular series of

‡ From the "Third Annual Report of the State Board of Health Massachusetts."

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symptoms in the persons occupying the room a given length of time. Other things being equal, the persons whom habit or occupation keeps much within doors would be most likely to suffer, and we should look for most numerous cases among women and young children. But, in point of fact, we find a great diversity of susceptibility. Among those who are even exposed continuously to the action of the poison, there occur instances of immunity. Such a case is cited by Dr. Guy:—

"I have myself known an instance of a spacious day and night nursery opening into each other, and covered with a flowered paper rich in emerald green, occupied for several months together by nurses and children, and yet without in any way affecting the health of the inmates. The poison in this case was so loosely laid on that it deeply stained a white handkerchief rubbed over it. This case is the more striking as it occurred in the house of a physician well acquainted with the effects of the poison and quite alive to their detection."*

But these negative cases are important only as showing the tolerance of a poison by the human system, and they do not annul the force of such testimony as has been quoted. It is a fact well recognised by physicians that different organisms vary exceedingly in their susceptibility to the action of drugs, and this idiosyncrasy will explain much of the diversity of effects observed in connection with the mode of chronic arsenical poisoning we are studying. An agent which is comparatively inert as regards one organism is to another an active poison. But because, for example, the poisonous ivy is to some persons harmless, or because certain people in Styria can swallow pure arsenic and appear to thrive upon it, there will yet be few of us who, knowing the possible results to ourselves in the one case or the other, would be quite willing to purposely test our own powers of tolerance. It is hardly justifiable, therefore, to put children to sleep in an atmosphere charged even slightly with arsenic, voluntarily trusting to the chances that such an exposure will be harmless.

When to this consideration of susceptibility are added other conditions, such as the previous health of persons, the degree of exposure (depending, primarily, on the amount and tenacity of the arsenic in the paper, and indirectly on attention to ventilation), or the eliminating power of the system, it will be seen how many circumstances influence the effect of the poison. Few will be found who, with any knowledge of the facts, will insist that a mineral agent which is capable, almost invariably, of producing well-recognised effects when taken into the stomach, is as invariably incapable of harm when it is more indirectly absorbed by the system through the mucous membrane of the respiratory organs; and few will be ready to take on themselves the voluntary risk of testing the question in their own persons by habitually dwelling in arsenical rooms, or will think it advisable that any human being should breathe the poisoned air of such rooms, even admitting that a portion of mankind is, in this respect, arsenic-proof.

The idea readily suggests itself that, if such effects as those described are to be observed in the occupants of rooms decorated with green paper, we ought certainly to discover some influence on the health of workmen who are exposed to the action of the arsenical pigments in the practice of their trades; and we should look for positive testimony from those engaged in the manufacture of the paper-hangings and from those who put the papers on the walls of rooms. And evidence of this kind is not wanting. The investigations of Chevallier, of Pietra-Santa, of Dr. Guy, and others show that a distinctive train of symptoms appears in those habitually engaged in making arsenical papers, and that these symptoms are referable to the arsenic in the pigment. According to these authorities, they are not unlike those already enumerated as observable in the occupants of arsenical rooms; they consist of thirst, nausea and vomiting, pain in the stomach and bowels, great prostration, disturbances of digestion, drowsiness, headache, nervous tremblings, and (traceable more directly to the local action of the arsenic) sore throat and irritation of the mucous membrane of the nose and mouth, showing itself in sneezing, a mucous or bloody discharge and swelling of the lips. Coincident with these is the appearance sometimes of various eruptions on exposed parts of the body, as the hands and face. These eruptions are sometimes mere pimples, sometimes they resemble erysipelas (erythematous), and sometimes they develope to ulcerations whose favourite seat is in the folds of the fingers and about the roots of the nails, where the pigment would be most likely to make a more or less permanent lodgment. These symptoms manifest themselves with a severity and uniformity in proportion to the degree, length, and continuity of exposure, to the workman's neglect of cleanliness, and to individual susceptibility to the poison; and they disappear spontaneously when the work in green colours is discontinued. The personal researches of the writer verify many of these observations.

Many paper-hangers, likewise, recognise the fact that certain green papers have a tendency to develop a peculiar set of symptoms in those engaged in fitting and hanging the paper on the walls of dwellings. These symptoms are of an acute character, manifesting themselves without delay and giving evidence of a local effect. They resemble, in many respects, those which characterise the beginning of an ordinary "cold in the head," and consist of sneezing, irritation of the eyes and nostrils, headache, and swelling of the lips; in the more severe forms of poisoning, there is vomiting, with diarrhœa and an indescribable feeling of illness. Many cases of this kind have been reported from time to time, and some instances are recorded in which the paper-hangers have asserted that they never could work upon certain green papers without being made seriously ill. In the course of this investigation, the writer has obtained information from paper-hangers which in many respects corroborated the observations recorded. Of nine of these men who were seen, seven had been poisoned by the arsenical wall-paper with various degrees of severity; the two negative cases were those of men who had not been long engaged in the business. Of the seven instances, one was especially marked. Within twelve hours after working upon a paper whose pigment was loosely laid on, the symptoms of poisoning showed themselves; there was irritation of the mucous membrane of the eyes, nose, and mouth, accompanied with great prostration of strength; presently, an eczematous eruption appeared on the hands and extended to other parts of the body, The illness was so severe as to necessitate entire suspension of his work, and he entered the hospital for treatment.

In the other cases, the symptoms were less serious, but they were sufficiently characteristic. Immediately consequent upon the work with the emerald-green papers, and disappearing within a week after the exposure ceased, the effects before described were experienced,—inflammation of the eyes (conjunctivitis), swelling of the nose with a mucous discharge, ulcerations about the nostrils, headache, sore lips, and sometimes bleeding from the nose.

The following instance has incidentally come to the writer's notice. Mr. W., a young man of robust constitution, a salesman in a paper-hangings store, complained of nausea, diarrhœa, great lassitude, inflammation of the conjunctiva, mucous discharge from the nose, and occasional dizziness. The symptoms could be explained by no unusual excess or exposure, and nothing was elicited to which his condition could be attributed save the fact that during the month previous he had exhibited to customers more patterns of arsenical green paper than usual.

To these statements concerning the ill effects experienced by workmen, exception will be taken by some. and especially by those interested in the manufacture and sale

* "Report of Medical Officer of Privy Council," p. 135.

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of paper-hangings, on the ground that none of the alleged injuries have occured under their observation. It may readily be seen that, notwithstanding its apparent partiality, such negative testimony might be given in all sincerity. The symptoms described are such as would naturally be referred to other causes; they are, in a measure, obscure; they occur with exceptional severity and they do not terminate fatally; they do not generally interfere with the performance of duty, and a workman would not be likely to complain of a condition of things of whose real character he had no certain knowledge, especially when he was dependent on his occupation for a livelihood.

This study of the employment of the arsenical-green pigments in various arts, and of the manifold noxious effects which directly or indirectly result, suggests, in conclusion, the consideration of some remedy for what we must term an evil. There will, of course, be those who will hesitate to condemn this use of arsenic, and who will hardly be ready to denominate it an evil. To those, for example, who regard fatality, the aggregate number of deaths, as the test by which the fruits of an alleged abuse are to be relatively judged, this whole inquiry will appear unnecessary, perhaps unjustifiable.

Not so do those reason who have themselves observed the ill consequences of too great trust in colour, or who have experienced those effects in their own persons. Those who realise that seriously impaired health does, in a certain number of cases, surely result from the employment of an active poison in the composition of a colour whose sole purpose is as a luxury to gratify the sense of vision, and which has not the smallest claim as a necessity, feel that an emphatic word of warning is imperative. It is to be remembered that the arsenical colours are poisons scarcely less active than the agent which gives them their name; and being colours simply, a single unequivocal instance of injury justifies their condemnation without the need of waiting until people are habitually killed by them.

Many suggestions have been made with the view to the protection of people from the harmful effects resulting from the arsenical greens. For example, the green wall-papers are to be covered with a layer of varnish; the workmen are to be specially instructed with regard to cleanliness; and so on. At best, these are but compromises and a partial remedy; and were it carried out as fully as practicable there would still be abundant exposure. If the use of arsenic in the relations we have studied is an evil, it is an absolute evil, concerning which the public may well be informed, for "the people perish for lack of knowledge" of the risks to which they unconsciously expose themselves in the means they take to gratify a refined taste for the beautiful.

If there can be awakened in the community some appreciation of the dangers which belong to the indiscriminate use of emerald-green colours, there will be no need to invent methods of repression in behalf of the public health; for reasonable people, informed concerning the risks, will not be likely to test their own tolerance of arsenic or to subject their children to it. The demand ceasing, the supply will cease; and a correct taste in colour will find its gratification in agents which possess no poisonous character.

LABORATORY NOTES.

TO CUT AND BORE INDIA-RUBBER CORKS.

Dip the knife, or cork-borer, in solution of caustic potash or soda. The strength is of very little consequence, but *it should not* be weaker than the ordinary reagent solution. *Alcohol is generally* recommended, and it works well until it evaporates, which is generally long before the cork is cut or bored through, and more has to be applied; water acts just as well as alcohol, and lasts longer. When, however, a tolerably sharp knife is moistened with soda-lye, it goes through india-rubber quite as easily as through common cork; and the same may be said of a cork-borer, of whatever size. I have frequently bored inch holes in large caoutchouc stoppers, perfectly smooth and cylindrical, by this method. In order to finish the hole without the usual contraction of its diameter, the stopper should be held firmly against a flat surface of common cork till the borer passes into the latter.

The above may not be new—in fact, the chances are greatly against it; but it will, I think, be new to at least as many of your readers as the instructions, abstracted in the June number of the *Journal of the Chemical Society*, for adapting tubes of different sizes to one another.

W. F. Donkin.

NOTICES OF BOOKS.

Michael Faraday. By J. H. Gladstone, Ph.D., F.R.S. London: Macmillan and Co. 1872.

This is a work which we notice with almost a reverence because of its subject. Faraday—the name alone calls to mind the picture of the philosopher, great in his simplicity—may be said to have inspired his biographers with such an affection, yet a touching sorrow, in their work, that the account of his life, whether written by either of the Professors De la Rive and Tyndall, or by either Drs. Bence Jones and Gladstone, is interesting even to those to whom chemistry and Faraday are unknown. We have in the present work by Dr. Gladstone much additional information, many unpublished incidents truly characteristic of the great philosopher. "His method of working" as analysed by Dr. Gladstone should be read by every chemist.

Contributions to Molecular Physics in the Domain of Radiant Heat. By John Tyndall, LL.D., F.R.S., Professor of Natural Philosophy in the Royal Institution. London: Longmans, Green, and Co. 1872.

This is a reprint of the series of Dr. Tyndall's memoirs published in the *Philosophical Transactions* and *Philosophical Magazine*. Much has been added, and to each memoir has been prefixed an analysis of its contents, from which the reader can at once learn the nature of the inquiry. This volume contains the conclusion of the discussion between Professor Magnus and Dr. Tyndall as to the action of air, and that of aqueous vapour upon radiant heat. The general reader who has mastered Dr. Tyndall's more popular work on the subject of heat, will find the present issue of much interest and high value.

Magnetism and Deviation of the Compass. By James Merrifield, LL.D., F.R.A.S. London: Longmans, Green, and Co. 1872.

The changes in the examinations conducted by the Board of Trade have produced among candidates the want of a small manual, embracing the necessary information on magnetism and deviation of the compass, and which should be adapted to the capacity of the student. This want is in this manual most admirably fulfilled, and the thanks of all students of navigation are due to Dr. Merrifield for his clear and easy exposition of the difficulties and anomalies attending the subject of compass deviation, more particularly in the case of iron ships and of the principles of the science of magn

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CORRESPONDENCE.

ARSENIC IN COLOURS.

To the Editor of the Chemical News.

Sir,—Reading in your columns Dr. Draper's article "On the Evil Effects of the Use of Arsenic in Certain Green Colours" brought to my recollection the examination of some pigments other than greens which contained arsenic.

The pigments were of French manufacture and said to be used in calico printing, and were sent here for trial, and rejected for two reasons—(1) because of the large quantity of arsenious oxide present; (2) because colours equally good could be obtained on calico by other methods, without the use of that dangerous substance and at less expense. The names were as follows:—

Light scarlet pigment.—Contained alumina, arsenious oxide, and aurine.

Scarlet ponceau.—Contained carbonate of lime in addition to above ingredients.

Dark green.—A preparation of aniline green and arsenious oxide.

Steam chocolate and catechu pigment.—Both contained arsenious oxide.

Now, as these lakes were very brilliant, I have no doubt they would be found suitable for paper-hangings. The arsenious oxide is not at all necessary for the production of the lake, but is used, I believe, solely for the purpose of giving body to the pigment.

My object in writing is to warn chemists of the necessity of examining for arsenic the bright scarlets, reds, and other pigments found in paper-hangings, as well as the greens.

I have no positive information as to whether any of these colours have actually been used for paper-hangings or not; but as such are undoubtedly prepared and to be had in the market, I have no doubt they will be sooner or later used for that purpose; in fact, I have recently seen, in an extract from a German journal, that Dr. Hallwachs had found arsenic in red paper-hangings.—I am, &c.,

J. Wallace Young.

Springfield Printworks, Glasgow.

DISEASED POTATOES.

To the Editor of the Chemical News.

Sir,—It may interest some of your readers to know that sulphite of lime appears to exercise a very remarkable influence in arresting the spread of the decay in potatoes affected by the disease now so prevalent.

In one experiment, this salt (which has been long applied in preserving meat) was dusted over some tubers, partly sound and partly affected, as they were being stowed away. Some months afterwards, the potatoes were found to have suffered no further injury. A comparative trial with powdered lime was much less successful.—I am, &c.,

A. H. Church.

Royal Agricultural College, Cirencester.

ESTIMATION OF NITRATES IN POTABLE WATERS.

To the Editor of the Chemical News.

Sir,—At the time of writing a letter to the Chemical News "On the Estimation of Nitrates in Potable Waters," which appeared a short time ago, I had not seen the excellent work on "Water Analysis," by Messrs. Wanklyn and Chapman, having practised their process from their original papers to the Chemical Society, and from the account of it given in Watts's "Dictionary;" I was not, therefore, aware that they had given a method almost exactly similar to that proposed by me, and I lay under the impression that no previous suggestion had been made to utilise the Nessler test in the estimation of nitric acid. I shall feel much obliged by your inserting this note.—I am, &c.,

Thomas P. Blunt.

The Wyle Cop, Shrewsbury, August 23, 1872.

MISCELLANEOUS.

British Association for the Advancement of Science.—The number of tickets issued at the Brighton Meeting was as follows:—Old life members, 245; new life members, 360; old annual members, 280; new annual members, 80; associates, 937; ladies, 912; foreign members, 43; total number of tickets, 2,533, representing £2,649.

Chemistry in Italy.—There are no handbooks on chemistry in the Italian language; but a work has been in course of publication since 1867 somewhat similar to the first edition of the celebrated German "Handwörterbuch der Reinen und Angewandten Chemie," viz., "Enciclopedia Chimica," edited by F. Selmi, of Bologna, with the co-operation of Arnaudon, of Turin, for technical chemistry, and of Sestini, Paterno, and others for pure chemistry. There are 2000 subscribers to this work, which is highly valued in Italy. The Italian Government has appointed Dr. Canizzaro, Professor of chemistry at Rome; and £20,000 has been voted by the Italian parliament for the establishment of a chemical laboratory in Rome. The Florentine Institute (*Instituto Superiore*) receives, in addition to its present subsidies, an annual subsidy of £25,000, and will be converted into a kind of Polytechnic University.

Plumbago.—The value of plumbago, or graphite, depends on its amount of carbon. In order to ascertain this, the simplest and best method is to dry the pulverised graphite at a temperature of some 360° F., and then place it in a tube, 4 to 5 inches long, and half an inch wide, made of hard glass and closed at one end. To this is added about twenty times as much well-dried oxide of lead, and the whole is well mixed. The tube is then first weighed, and afterwards heated before the blowpipe till the contents are completely effused and no longer evolve gases. After this operation, which does not last longer than ten minutes (if the quantity is not too large), the tube is allowed to cool, and its weight is again ascertained. The loss in weight is carbonic acid, the oxygen of which has been taken from the lead oxide, while the carbon is all that there was in the plumbago. For every 28 parts of loss, there must have been 12 of carbon. In general, it is sufficient to take from 1 to 2 grms. of plumbago, and from 20 to 40 of oxide of lead.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, August 19, 1872.

This number contains the following original papers and memoirs relating to chemistry:—

Action of Ozone upon Sulphate of Indigo and upon Arsenious Acid.—A. Thenard and P. Thenard.—This essay records the results of a series of experiments made to ascertain, if possible, the real

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nature of ozone. The quantity of ozone required to oxidise arsenious acid is equal to the quantity of oxygen required for the same purpose; it appears that ozone oxidises three times as much indigo as permanganate of potassa and other oxidising substances; it has, moreover, been found by the authors that with ozone there is a continuous action, which they consider due to the formation of peroxide of hydrogen.

Investigation of the Meteorites which Fell on July 23 last at Lancé and at Authon (Loir et Cher).—M. Daubrée.—One of these minerals weighs 47 kilos. The results of the author's analysis are the following, in 100 parts:—Free iron, alloyed with nickel and cobalt, 7·81. Iron and other metals (including a small quantity of copper, detected by spectrum analysis) combined with sulphur, 9·09; combined sulphur, 5·19; together, 14·28. Silicates acted upon by acids—Silica, 17·20; magnesia, 13·86; protoxide of iron, 11·33; protoxide of manganese, 0·05; together, 42·41. Portion insoluble in acids, 33·44; chloride of sodium, 0·12; hygrometric moisture, 1·24.

Action which Silica and some Analogous Oxides Exert upon Carbonate of Soda at a High Temperature.—M. Mallard.—The main gist of the contents of this memoir is that when silica, SiO_2, titanic acid, TiO_2, and zircona, ZrO_2, are brought into contact with carbonate of soda, and strongly heated, the quantity of carbonic acid disengaged tends to a certain limit which it is impossible to overcome, and which increases with an increase of temperature. The author explains this by the mutual action of the bisilicate upon the protosilicate, comparing the phenomenon to the decomposition observed by Berthelot of the acid salts of the bibasic acids when in solution.

Bequest to the Academy.—Dr. J. Dumas.—As one of the Perpetual Secretaries, the eminent *savant* communicates that the late Field-Marshal Vaillant has bequeathed to the Academy a sum of 40,000 francs, the interest of which is to establish a biannual prize for any subject the Academy thinks fit to select.

Compressibility of Hydrogen and Air at High Temperatures.—M. Amagat.—The author describes at length his method of experimenting, and quotes the following results:—

	Air.	Hydrogen.
At 100°	1·00011	—
At 250°	1·00025	0·99986
At 320°	1·00018	—

Division of One Base between Several Acids while in Solution; Bibasic Acids.—Dr. Berthelot.—The continuation of a series of memoirs on this subject; this portion is elucidated by several tables.

Tendency of Certain Gases to Obtain Permanently-Active Properties Under the Influence of Electricity.—M. Chabrier.—This memoir contains the detailed account of the author's researches concerning hydrogen, which, when electrised by means of Houzeau's ozoniseur, was found to combine directly with nitrogen, forming ammonia; this hydrogen was also found to decompose freshly-made oxide of silver, metallic silver being formed, and so much heat was evolved that the metal melted, although the experiment took place at the ordinary temperature of the air.

Artificial Production of Pyroxen and Peridote.—G. Lechartier.—This essay records the results of the author's experiments, made with the view of artificially producing the minerals known as pyroxen and peridote; full details of the quantities of the constituents of these minerals to be mixed and of the mode of operation are given.

This number also contains important original papers relating to astronomy, meteorology, geology, physiology, and natural history.

Le Moniteur Scientifique Quesneville, No. 368, August, 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

On Pulmonary Respiration and on Animal Heat.—Ch. Blondeau.—A lengthy chemico-physiological monograph on this subject.

Chemical Researches on Condurango.—G. Vulpius.—There are two drugs of this name met with in commerce; one of these, which has been known for the last ten years, generally termed guaco, consists of the cut-up branches and young twigs of the *Mikania guaco*, a native of Venezuela; the other, the subject of this memoir, is obtained from Chili, but the plant or tree it is derived from is at present not well known. The author found, in the sample he investigated, 12 per cent of a white-coloured ash, of which 16·7 per cent was soluble in water. The bark was treated first with ether, yielding 5·2 per cent of dry ethereal extract; with alcohol, the residue of this operation yielded 8·94 per cent of dry alcoholic extract. This residue was then treated with water, yielding 1·13 per cent of dry aqueous extract; on treating this residue with dilute hydrochloric acid (1 part of pure HCl and 19 parts of water) the author obtained, on evaporation of the chloroform solution of a lime precipitate, a small quantity of a resinous matter, while a further treatment of the residue of the bark, with a weak (5 per cent) caustic potassa solution, yielded no active principle, as regards the bark; the author considers this is due to the presence therein of two resinous compounds, which in concentrated state are best obtained in the form of tincture or alcoholic extract, by means of very strong alcohol. According to Dr. Triana, the condurango, more correctly cundurangu, is the bark of the *Gonolobus cundurango*, a tree met with in several regions of South America.

Anthracen and its Derivatives.—Dr. E. Kopp.—The continuation of an exhaustive monograph on this subject, this portion being divided into the following sections:—Properties of alizarine; alkaline alizarates; alizarate of ammonia, and alizaramide or alizaréine.

Isopurpurine Extracted from Artificially-Prepared Alizarin Obtained from Gessert Brothers, at Elberfeld.—Dr. Auerbach.—From the crude substance (artificially-prepared alizarine) the author obtains the isopurpurine, by first treating the raw material with a dilute solution of caustic alkali, and precipitating with chloride of calcium; the coloured lime-lake thus formed is treated with boiling water until it ceases to be coloured; this fluid is precipitated with hydrochloric acid, and the precipitate again converted into a lime-lake, an operation to be repeated several times in order to completely eliminate the alizarine. The pure substance, obtained by the aid of re-crystallisation from an alcoholic solution, is soluble in caustic soda, the solution exhibiting an orange colour; its chemical composition, in 100 parts, is—C, 70·76; H, 3·57; O, 25·67. In many of its properties it resembles anthraflavic acid, but isopurpurine is not identical with purpurine, although the two substances agree as regards the dyeing of mordanted cotton.

C. A. de Natiselle's Crystallised Digitaline.—Dr. Quesneville.—This lengthy memoir treats exhaustively on the subject of crystallised digitaline, reviewing the labours and researches of Latour, Gubler, Homolle, Nativelle, and others, as regards physiological experiments and chemical investigations.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, June 9, 1872.

Artificially-Made Butter.—Mège-Mouriez.—Some years ago the author was requested by the Victualling Department of the French Navy to try to find a wholesome substitute for butter, which would not become rancid by keeping. Experiments made with cows, submitted to a very severe and scanty diet, led to the discovery that these animals continued to give milk, although in very much smaller quantity, and that this milk always contained butter; the author surmised that this butter was due to the absorption of the fat contained in the animal tissues, which was converted into butter under the influence of the milk-secreting glands. This led to experiments on the splitting up of animal fats, and, further, to the following process for making butter artificially. Best fresh beef-suet is first mechanically cut up, by means of circular saws fitted to a cylinder, and is next placed in a vessel containing water, carbonate of potassa, and fresh sheep's stomachs previously cut up into small fragments; the temperature of this mixture having been raised to 45°, the joint influence of the pepsine of the stomachs and heat causes the fat to be separated from the cellular tissue; the fatty matter floating on the top is decanted, and, after cooling, submitted to very powerful hydraulic pressure; the stearine is used in candle-making, and the semi-fluid oleomargarine is used for making the artificial butter in the following manner:—50 kilos. of the fat are poured, along with 25 litres of milk and 20 litres of water, into a churn, while there is added 100 grms. of the soluble matter obtained by soaking for some hours in milk from cows' udders and milk-glands; a small quantity of annatto is also added, and the operation of churning then proceeded with. The butter thus obtained is well washed with cold water, and, if required to be kept for a long time, melted by a gentle heat, to eliminate all the water. According to reports of sanitary committees, as well as of the authorities of the Victualling Department of the French Navy, this artificial butter is really an excellent substitute for genuine butter, and can be exposed for sale if the vessels are marked to distinguish the artificial from the genuine butter.

Hydraulic Blowpipe and Aspirator-Apparatus for Chemical Laboratories.—Dr. H. Sainte-Claire Deville.—This memoir, illustrated by woodcuts, contains the detailed description of an apparatus, the principle of action of which is based upon the well-known Catalan blowing-machines. By the arrangement here described, a very powerful blast can be obtained, as well as an aspirator-apparatus, which are constructed by M. Wiesnegg at Paris, the cost, with accessories, being about £5.

Manure for Beet-Roots and other Crops.—Crespel and Co.—In order to withdraw the free sulphuric acid from the beet-root vinasse, the authors add carbonate of baryta, and, when no more effervescence ensues, the precipitated material is drained, and next pressed by means of hydraulic presses; this product constitutes the manure, which, according to an analysis of Professor Violette at Lille, contains, in 100 parts—Nitrogen, 1·42; non-nitrogenous organic matter, 20·33; phosphate of lime, 1·50; sulphate of lime, carbonates, and alkaline salts, 11·32; sand, clay, &c., 65·45. This manure has been found to answer well for beet-roots, and is cheap.

Manufacture of so-called Porcelain Buttons.—C. Mène.—The detailed description of a process of making a peculiar kind of ceramic paste, which is moulded into buttons; felspar, sulphate of lime, phosphate of lime, and other minerals are used in this industry, which is carried on, it appears, on a large scale in some districts of France.

Pharmaceutische Zeitschrift für Russland, No. 4, 1872.

This number contains no original papers relating to chemistry.

No. 5, 1872.

Description of an Apparatus Contrived with the View of Regulating Gas- and Spirit-Lamp Flames so as to keep up a Fixed Temperature for a Length of Time.—Dr. J. Martenson.—This paper is illustrated by a woodcut.

Nomenclature of the Alcohol Radicals.—J. Biel.—After referring to the inconvenience of the prefixes pseudo, iso, and pseudo-iso, and also to the difficulty arising from the use of expressions such as butylen from erythrite, butylen from allyl, and butylen from

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trimethyl-carbinol, the author proposes that the use of α, β, γ, δ, &c., shall be applied to the hydrocarbon radical, as well as to the corresponding alcohol and the acid belonging to the same radical; as instances, the following isomers of amyl, amylic alcohol, and capronic acid, are quoted:—

Hydrocarbon Radical.	Corresponding Alcohol.	Capronic Acid containing the same Radical.
(1). α amyl, butylated methyl.	α amylic alcohol, normal primary amylic alcohol.	
(2). β amyl, dimethyl propyl.	β amylic alcohol, fermentation amylic alcohol, primary amylic alcohol.	β capronic acid prepared from cyanide of amyl.
(3). γ amyl, ethylo-methylated ethyl.	γ amylic alcohol, unknown primary amylic alcohol.	
(4). δ amyl, trimethyl ethyl.	δ amylic alcohol, unknown primary amylic alcohol.	
(5). ε amyl, diethylated methyl.	ε amylic alcohol, unknown secondary amylic alcohol.	ε capronic acid, diethylacetic acid.
(6). ζ amyl, methylo-propylated methyl.	ζ amylic alcohol, secondary amylic alcohol, iso-amylic alcohol.	
(7). η amyl, methylo-pseudopropylated methyl.	η amylic alcohol, secondary pseudo-amylic alcohol, amylen hydrate.	η capronic acid from amylen hydrate.
(8). θ amyl, dimethylo-ethylated methyl.	θ amylic alcohol, tertiary pseudo-amylic alcohol.	

Nos. 6 and 7, 1872.

These numbers contain the following original paper relating to chemistry:—

Platinocyanides and Tartrates of Beryllium.—Dr. F. Tocksynski.—This exhaustive monograph is divided into the following sections:—Preparation and analytical characters of beryllium oxide; platinocyanides of beryllium; cyanide of beryllium; ferrocyanide of beryllium; ferricyanide of beryllium; rhodan-beryllium; nitroprussid-beryllium; beryllium platincyanide; beryllium-magnesium platincyanide; tartrates of beryllium; potassium-monoberyllium tartrate; potassium-diberyllium tartrate; stibium-monoberyllium tartrate; stibium-sesquiberyllium tartrate; formulæ of the double tartrates of beryllium—

Tartaric acid .. .. $C_{12}H_8H_2H_{12}O_{18}$
Bitartrate of potassa .. .. .. $C_{12}H_2K_2H_{12}O_{18}$
Potassium-diberyllium tartrate .. $C_{12}H_2K_2\overset{XII}{Be_2}O_{18}$
Potassium-monoberyllium tartrate $C_{12}H_2K_2\overset{VI}{Be_2}H_6O_{18}$
Werther's copper salt .. .. .. $C_{12}H_2H_2Na_2\overset{IX}{Cu_4}O_{18}$
Stibium, or antimonium-sesquiberyllium tartrate .. .. .. $C_{12}H_2H_2\overset{VI}{Be_2}\overset{VI}{Sb_2}O_{18}$
Antimonio-tartrate of potassa .. $C_{12}H_2H_2K_2\overset{IX}{Sb_2}O_{18}$

No. 8, 1872.

This number contains no original papers relating to chemistry.

No. 9, 1872.

The only paper relating to chemistry in this number is—

Relation of Modern Chemistry to Metallurgy.—Dr. C. Winkler.—The first instalment of a monograph written with the view of rendering the study of modern chemistry more in harmony with the practice of metallurgy. Speaking of hydrogenium, the author states that in the solid state it is a white-coloured, magnetic, rather tough metal, of about 0·733 sp. gr., and a good conductor of electricity.

Les Mondes, August 22, 1872.

French Association for the Advancement of Sciences.—The first meeting of this Association will be held from the 5th to 12th of September next in the City of Bordeaux. There will be two general meetings, sectional meetings, public conferences, and scientific excursions extending to the Departments of the Landes, Gers Gironde, and Charente Inférieure, with the view of visiting important industrial works, parks in which oysters and sea-fish are cultivated, vineyards, open air magnaneries, salt and iron mines. Among the subjects on which public lectures will be given we notice the following:—Constitution of the sun; troglodytes of Eysies; commercial geography; exploration journey of the Cambodge; and the politico-commercial influence of France in the far East. The Association already possesses a capital of upwards of £5000, a sum which it is expected will soon be greatly increased.

International Congress of Weights and Measures.—This congress, to which delegates from almost all European countries are expected to attend, will be held at Paris on the 24th of September next. The main point to be discussed will be the adoption, if possible, of a uniform international system of weights and measures, in order to obviate the difficulties experienced by commerce from the want of such a system in Europe.

Active Hydrogen.—M. Chabrier.—The author has discovered that, when hydrogen is electrised by an electric discharge, and not attended with sparks, it then directly combines with nitrogen, forming ammonia. Under the same conditions, hydrogen decomposes freshly-made oxide of silver; and so much heat is evolved by this operation that the globules of metallic silver melt, and in a state of high incandescence take up oxygen, which, on cooling, is given off, producing the well-known phenomenon also observed in the silver assay by the dry way.

Freezing of Water.—C. Tellier.—It is generally admitted that water freezes at 0°, and can only be cooled down below its freezing-point by being kept perfectly tranquil. This holds good for a cold of −10° or −12°, but is, according to the author, not true for temperatures of −3° or −4°; because water may be cooled down to these degrees of temperature, and will not freeze even when the vessel containing it is very violently shaken or stirred. Only a sudden and very violent shock to the vessel will cause the water to become frozen, the temperature rising to 0°; but if, in water cooled down to −3° or −4°, the slightest particle of ice or snow is put, congelation briskly sets in and crystallisation ensues, just as in a supersaturated solution of sulphate of soda. Practically, this observation is important, as it proves the necessity of water containing ice if it is desired to cool it down to 0° precisely.

Modifications of the Electric Machine.—L. Brunelli.—The description, illustrated by engravings, of an arrangement whereby the electric machine is rendered more effective and powerful.

Asbestos for Use in the Stuffing-Boxes of Steam-Engines.—M. Day.—It appears that asbestos is an excellent and durable substitute for hemp or flax in the stuffing-boxes of steam-engines, because asbestos better resists the joint action of friction, humidity, and high temperature.

Saltpetre in South America.—Rev. F. Moigno.—The author states that, according to a low calculation, there is at Tamarugal alone, where the nitre beds extend over 483 square miles, a quantity of saltpetre equal to 63,000,000 tons, sufficient at the present rate of consumption for 1393 years, while larger quantities of this salt are known to exist at the foot of the Cordilleras.

Journal de Pharmacie et de Chimie, August, 1872.

In addition to several papers relating to pharmacy, this number contains the following:—

General Method of Immediate Organic Analysis.—Dr. Fleury.—The continuation of a monograph on this subject, this portion being divided into the following sections:—Investigation of aqueous fluid; treatment with alcohol.

Sulphydrate of Chloral (Sulphuretted Chloral).—H. Byasson.—When anhydrous chloral is acted upon by sulphuretted hydrogen, there is formed, while a very perceptible amount of heat is evolved, sulphydrate of chloral, a solid white-coloured body, which is soluble in ether, in anhydrous alcohol, and chloroform, and may be obtained from these solutions in crystalline state; this substance fuses at 77°, and boils at 123°; water decomposes it, the result being the formation of sulphuretted hydrogen, which escapes, while the fluid contains hydrochloric acid and hydrate of chloral in solution. Under the influence of hydrated alkalies and ammonia, it is rapidly decomposed; there are formed sulphydrates of the alkaline metals, as well as formiates and chlorides of the bases. Nitric acid violently decomposes sulphydrate of chloral, while cold concentrated sulphuric acid has no action upon that substance, but, when hot, sulphuric acid converts it into hydrate of chloral, sulphuretted hydrogen and sulphurous acid being evolved.

Aspect of Milk Seen Under the Microscope before and after Churning and Creaming it.—M. Boussingault.—This paper, illustrated with engravings, contains some important observations on the operation of churning. It appears that from ~~100~~ 1000 parts of milk, containing 40·4 of butter, only 29·5 were obtained by churning, leaving behind in the butter-milk 10·9 parts; milk which is creamed under the most favourable conditions yet retains from 0·3 to 0·4 per cent of butter. By means of the microscope, cream, skim-milk, butter-milk, and whey may be perfectly well recognised.

Some Compounds of Paraffin.—M. Champion.—When paraffin is kept for sixty hours at 90°, in the presence of nitrosulphuric acid, there is formed (while copious vapours of nitrous acid are evolved) a fluid of 1·14 sp. gr. at 15°, which is insoluble in water, but soluble in alcohol, ether, and amylic and methylic alcohols. This compound combines with alkalies, and has been termed paraffinic acid, $C_{26}H_{24}NO_{10}$. Ethyl, methyl, and amyl compounds of this acid have been obtained by the author; the formula of the ethyl compound is $C_{26}H_{23}(C_4H_5)NO_{10}$.

Journal für Gasbeleuchtung und Wasserversorgung, No. 12, 1872.

This number contains, in addition to several original papers strictly relating to gas- and water-works' engineering, a paper—

Purification of Glycerine which has been Used in Gas-Meters.—M. Hasse.—After stating that at Dresden glycerine is generally used in gas-meters, the author gives a detailed account of a process for purifying the glycerine after it has been some four years in the meters, so as to render it fit for use again. The fluid is first heated for twelve hours to from 50° to 60°, and next to from 120° to 130° in order to eliminate water, ammoniacal compounds, and other volatile impurities; the glycerine is next filtered over granulated animal charcoal. Some 300 to 400 cwts. of glycerine are annually purified in this manner at Dresden.

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NOTES AND QUERIES.

Dryer for Tarry Substances.—(Reply to C. E.)—Your best plan to obtain a quickly-drying tar is to boil it, and apply it hot; and if expense is not an object, add some Trinidad asphalte or bitumen to it while boiling.

Manufacture of Iodine.—(Reply to "Medicus.")—In Mr. Crookes's edition of Wagner's "Chemical Technology," published by Messrs. Churchill, there is a complete account of the preparation of iodine from kelp and from the mother-liquors left by crude nitrate of soda and common sea-salt manufacture.

PATENTS.

Communicated by Messrs. VAUGHAN and SON, Patent Agents, 54, Chancery Lane, London, W.C.

NOTICES TO PROCEED.

1044. W. R. Lake, Southampton Buildings, London, "Improvements in the manufacture of pulp from vegetable fibres for making paper and other materials."—A communication from G. Swift, San Francisco, California, U.S.A.—Petition recorded April 8, 1872.

1054. E. Sonstadt, Ramsey, Isle of Man, "Improvements in the manufacture of iodide of potassium and bromide of potassium."—Petition recorded April 10, 1872.

1088. W. R. Lake, Southampton Buildings, London, "An improved process of converting cast-iron and articles made thereof into steel."—A communication from H. H. Date and J. F. Date, St. Catherine's, Ontario, Canada.—Petition recorded April 12, 1872.

1103. R. Tierman, Liverpool, "An improved manner of treating tobacco."—Petition recorded April 13, 1872.

1265. E. A. Cowper, Westminster, "Improvements in the process of converting wood and other fibrous materials into pulp, and in apparatus therefor."—Petition recorded April 27, 1872.

2279. J. Brown, Edinburgh, N.B., "Improvements in the treatment of sewage and in the manufacturing of manures."—Petition recorded July 30, 1872.

PATENTS GRANTED IN BRITISH COLONIES.

TRINIDAD.

FROM THE YEAR 1852 TO THE YEAR 1867, BOTH INCLUSIVE.

1. J. Ramos, "A process for the better classification of the expressed juice of the sugar-cane while being manufactured into sugar." (1852).

2. J. Brandeis, "Certain improvements in the manufacture and refining of sugar." (1853).

3. A. W. Anderson, "Certain improvements in the manufacture of sugar." (1853).

4. A. A. L. Cochrane, "Certain improvements in the use of the bitumen of this colony in the manufacture of fuel." (1854).

7. H. Hyde, "Certain improvements in the preparation of mineral oils." (1856).

9. S. R. Philbrick, "A new apparatus for distilling the asphalte of this island, and a new process for obtaining an illuminating oil from the asphalte of this island, or the distillates of such asphalte." (1857).

10. H. S. Warner, "Certain improvements in preparing decolouring charcoal." (1857).

13. H. S. Warner, "Certain improvements in preparing asphaltic fuel." (1859).

14. H. Mitchell, "A new apparatus for distilling the asphaltum and other naphthaline exudations of this island, and also a new process for obtaining greasy or oily products from the asphaltum of Trinidad, or the distillates of such asphaltum." (1859).

15. C. F. Stollmeyer, "Certain improvements in preparing and combining divers materials to form a strong and concentrated manure." (1859).

18. H. W. R. Ellis, "An improvement in the manufacture of sugar." (1860).

19. H. W. R. Ellis, "An improvement in the distillation of rum." (1860).

20. H. S. Warner, "Certain improvements in furnaces, and in the treatment of megass as fuel." (1860).

21. L. A. Le Roy, "Certain apparatus for and improvements in the preparation of megass for use as fuel." (1861).

22. The Earl of Dundonald, "Certain improvements in obtaining products from coal, gas tar, gas pitch, asphalte, resin, and other bituminous and resinous substances." (1861).

24. P. Rostaut, "Preparation of megass for use as fuel." (1861).

27. The Earl of Dundonald, "An improved mode of concentrating and purifying asphalte or bitumen." (1862).

29. P. Rostaut, "The preparation of megass for use as fuel." (1863).

30. A. L. Possoz, "Improvements in the manufacture of sugar." (1863).

32. The Earl of Dundonald, "Improvements in the manufacture of paraffine and hydrocarbon oils." (1864).

36. W. Knaggs, "Improvements in the manufacture of sugar, and in the apparatus employed therein." (1867.)

38. W. E. Gedge, "An improved process for extracting the juice of sugar-cane, beet-root, and other plants." (1867).

39. R. S. Lambert, "Certain improvements in the method of and in the apparatus used in the process of combining sulphurous and other gases with mineral bases." (1867).

40. W. G. S. Mockford, "Certain improvements in the manufacture of sugar, especially for separating crystals of sugar from molasses and alkaline salts." (1867).

41. L. Agostini, "Improvements n the manufacture of sugar." (1867).

42. L. Agostini, "An improved method of manufacturing Muscovado sugar in a concrete form." (1867).

47. F. Kobn, "Improvements in the mode of extracting the juice from sugar-cane, beet-root, and other plants." (1867).

48. R. A. Stewart, "For clarifying and defecating cane juice direct from the mill." (1867).

50. W. Garton, "Improvements in the manufacture of inverne sugar, a saccharine material to be employed in brewing and wine-making." (1867).

VICTORIA.

APPLICATIONS FOR PATENTS.

1625. G. A. Lloyd, Sydney, New South Wales, "A new compound to be used as an explosive agent, and called 'Judson's powder.'"—A communication from E. Judson, San Francisco, U.S.A.—Dated April 26, 1872.

1628. J. Watteau, Antwerp, Belgium, "An improved depilatory composition for hides and skins."—Dated May 6, 1872.

PATENT GRANTED.

1616. F. Sacc, Neuchatel, Switzerland, "Improvements in the preservation of fresh meat and vegetables, and in the preparation of extract of meat."—Dated March 18, 1872.

FOREIGN PATENTS.

FRANCE.

94737. Balpétré and Donneaud, "Manufacturing liqueur-chocolate."—Dated April 11, 1872.

94754. Guétat, senr., "Reducing and utilising spent baths of chromate, employed in dyeing and printing fabrics."—Dated April 4, 1872.

94787. Herpé, "Obtaining paper and card pulp from the ferula plant."—Dated April 5, 1872.

94792. Morida, "Ventilators and furnaces for burning sea-wrack, and for obtaining charcoal, ashes, and soda, &c."—Dated April 18, 1872.

94796. Sala, "A chemical compound for working quarries and mines."—Dated April 17, 1872.

94804. Anthony, "A vegetable substance for colouring butter."—Dated April 8, 1872.

94808. Bourry, "A chemical process for cleaning wool and woollen fabrics, and also in separating vegetable substances from woollen rags."—Dated April 25, 1872.

94816. Faure and Kessler, "Improvements in concentrating and evaporating various liquids, and especially sulphuric acid at 66°."—Dated April 10, 1872.

94817. Fournier, Pointis, and Durand, "Black of boghead waste."—Dated April 9, 1872.

94824. Lestage, "Decolouring colophany and resinous products."—Dated April 22, 1872.

94830. Piedallu, "A process of tanning hides and means of smoothing and hardening leather."—Dated April 6, 1872.

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THE CHEMICAL NEWS.

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ON FILIFORM NATIVE SILVER.*

By Dr. J. H. GLADSTONE, F.R.S.

NATIVE silver occurs frequently as metallic threads or wires twisted in every direction, and often bent at sharp angles. Specimens of this filiform silver were exhibited, from Kongsberg, in Norway, associated with calc spar, and from Chili, associated with greenstone, and it was shown that the metal was tough and non-crystalline. Precisely similar threads of silver were produced under the microscope, by decomposing a solution of nitrate of silver with suboxide of copper. The white filaments shoot forth in every direction, and twist about or double back in their course; while the cuprous oxide becomes black, splitting up, in fact, into cupric oxide and cupric nitrate. Most of these threads are so fine that their diameter is only $\frac{1}{2500}$th of an inch, and a gramme of such silver wire would stretch from London to Brighton, and many are much finer still. Sometimes these filaments will end in crystalline knobs, or crystals of silver will form upon them, as is not unfrequently the case in mineralogical specimens. Attempts to prepare them by means of other substances than suboxide of copper had not proved successful; but, as that substance is by no means a rare mineral, it was thought that their formation might result generally from its action on silver salts in solution.

ON THE MUTUAL HELPFULNESS OF CHEMICAL AFFINITY, HEAT, AND ELECTRICITY, IN PRODUCING THE DECOMPOSITION OF WATER.*

By J. H. GLADSTONE, F.R.S., and ALFRED TRIBE, F.C.S.

SOME metals are able of themselves to displace the hydrogen of pure water, while other metals are unable. Zinc, if perfectly pure, is just incapable of doing so; but, if it be brought into contact with another metal still further removed from the power of effecting the decomposition of water, the electric force started by the contact of the two metals enhances the chemical affinity sufficiently to make it effective; or (otherwise expressed) the chemical force *plus* the electrical increase the tension of water sufficiently to effect its decomposion. The junction of the metals may be made outside the water by a wire; and the amount of action may be determined by a Thomson's galvanometer. The effect of varying the distance of two plates of zinc and copper was tried, and it was found that the chemical action increases slowly till the plates are within about an inch of one another, but on continuing to bring them nearer the action increases at a rapidly accelerating ratio. If the water be heated when it is exposed to this joint action of chemical and electrical force it decomposes more readily. In experiments made with two plates, about 1·5 inches distant from one another, the deflection of the galvanometer showed that the effect of raising the temperature from 40° to 80° C. was more than double of that between 20° C. and 40° C.; but in an experiment made when the copper was deposited in a spongy condition on the zinc,† and the hydrogen gas produced was collected, the following numbers were obtained:—

Mean Temperature.	Duration of Experiment.	Hydrogen collected.	Hydrogen per hour.
2·2° C.	3 hours	3·4 c.c.	1·1 c.c.
22·2° ,,	2 ,,	11·1 ,,	5·5 ,,
34·4° ,,	45 mins.	10·4 ,,	13·9 ,,
55·0° ,,	15 ,,	15·5 ,,	62·0 ,,
74·4° ,,	10 ,,	29·1 ,,	174·6 ,,
93·0° ,,	5 ,,	44·0 ,,	528·0 ,,

The last column shows the extraordinary acceleration of the action due to heat.

Magnesium is capable by itself of decomposing water, but its action is greatly increased by touching it with a piece of copper, and some of the hydrogen gas then makes its appearance on the copper plate.

If, instead of magnesium, we take a metal less capable than zinc of decomposing water, we still find a deflection of the galvanometer if it be united with another metal still more negative. The order for pure water seems to be—Platinum, silver, copper, iron, tin, lead, zinc, magnesium.

Experiments were made on the effect of electrical action by using the force generated in one cell of Daniell instead of the force generated by the contact of the metals experimented on. It might be inferred that the electrolysis of water would be more easily effected between the poles made of a metal that has a considerable affinity for oxygen than between poles of a metal which has little affinity. And so it is. When zinc poles were used, there was found to be more than double the action that there was when platinum poles of the same size and at the same distance were employed. The order of efficiency for poles in the electrolysis of water, after about a minute, seems to be—Platinum, tin, silver, copper, iron, lead, zinc, magnesium. After a few minutes the power of tin was found to rise above that of copper. The other metals are in the same order as in the previous list, where they themselves produced the electricity by their joint action on water.

The effect of heat on the electrolysis of water was tried with two zinc poles. The deflection increased about four-fold between 5° and 80° C., and the action increases nearly *pari passu* with the temperature.

If, instead of employing two poles of the same metal, we use dissimilar metals, we have a current established by these two metals, which, according to its direction, either adds to or subtracts from the current originating in the Daniell's cell. Thus, if two poles of platinum be employed, the effect with water is very minute; but if the negative pole be replaced by one of zinc, pure water is decomposed by one cell of Daniell's battery, with visible evolution of hydrogen gas. The experiment was performed quantitatively with poles of silver and zinc.

Positive.	Negative.	Deflection.
Silver	Silver	27
Zinc	Silver	52
Silver	Zinc	7
Zinc	Zinc	33

When, therefore, the dissimilar metals were employed as poles, the decomposition of the water was not the mean of that producible by silver and by zinc, viz., 30, but 30 + 22 when the two forces acted in the same direction, and 30 − 23 when they acted against one another.

THE PRESENCE OF DIDYMIUM IN A SPECIMEN OF PYROMORPHITE.

By CHARLES HORNER.

WHEN recently examining some pyromorphite from Cumberland, I found didymium present in one of the specimens, and, by the intensity of the absorption-lines, should judge the quantity to equal that found in asparagus-stone.

The fact is interesting, since I believe this to be the first published notice of the presence of didymium in an English mineral.

Mortlake, Aug. 24, 1872.

* Read before the British Association, Brighton Meeting, Section B.

† *Proc. Roy. Soc.*, vol. xx., p. 218.

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ON THE

EFFECT UPON METEORIC IRON, AS REGARDS THE CAPABILITY OF BEING FORGED, OF PREVIOUS HEATING TO REDNESS OR WHITENESS IN VACUO.*

By J. W. MALLET, Ph.D., M.D.,
Professor of Pure and Applied Chemistry, University of Virginia.

THREE specimens were exhibited of meteoric iron from Augusta County, Virginia. Of these, the first had been cut from the original mass by a planing machine, and, without further preparation, had been forged into a tolerably perfect blade for a paper-knife. The second had been heated to strong redness in a porcelain tube rendered vacuous by a Sprengel pump (for the purpose of examining the occluded gases), and had then been with much difficulty forged into a blade of similar kind, in which cracks and flaws were visible. The third had been heated in like manner *in vacuo*, but to a white heat; and this specimen, it was found, could not be forged at all, crumbling under the hammer when re-heated.

The conceivable causes of these differences were briefly discussed, such as the more or less complete removal of the occluded gases, changed state of combination of the phosphorus (and sulphur), and melting out of phosphide of iron leaving the iron porous.

ESTIMATION OF WORK IN SALINE SOLUTIONS.

MM. FAVRE and Valson have recently communicated to the Paris Academy an account of some researches by them on this subject, of which we give the following abstract.

When a salt is dissolved in water, there is generally a contraction of the entire volume, which may be easily determined by comparing the density of the solution with the respective densities of the salt and the liquid. But contraction of volume may be produced differently, as by a lowering of temperature, or by mechanical compression. The contractions in these three cases, then, may be considered as effects of the same order, and therefore equivalent with reference to the forces producing them. And as the two last mentioned permit of being measured directly, we may deduce from them a measure of the forces acting in the first. True, the case of the solution is more complex, for, along with contraction of the liquid, there is expansion of the salt, in consequence of the heat yielded by the solvent. But this is so small an element, that, in a first study of the phenomenon it may be neglected.

Suppose, then, a contraction of water through lowering of temperature. Its coefficient of expansion at 15° being about 0·0001320, it follows that, in cooling 1° from this temperature, a litre of water is reduced to 999·8680 c.c., and that a contraction of 1 c.c. per litre is equivalent to a lowering of temperature 7·576°, corresponding to 7576 calories (the grm. being taken as unit). On the other hand, this number measures the work necessary to compress a litre of water and diminish its volume 1 c.c. at 15°.

Suppose, next, a contraction through mechanical compression. The compressibility of water is given by M. Regnault as 0·00004685 per atmosphere; hence, on an increase of pressure 1 atmosphere, a litre will contract 0·04685; and to produce a contraction of 1 c.c., the increase of pressure necessary would be $\frac{1}{0{\cdot}04685} = 21{\cdot}34$ atmospheres.

It is supposed that such a compression would disengage 7576 calories, and MM. Favre and Valson propose to submit this point to experimental verification.

Consider, thirdly, the case of a salt dissolved in water. In order to have a proper idea of this, it may be of use to compare the well-known phenomenon of condensation of certain gases by solid substances, *e.g.* that of carbonic acid by carbon. An equivalent of carbonic acid, passing from the gaseous to the solid state, disengages 3053 calories; whereas in its condensation by carbon it disengages 3278; whence we may infer that the condensation is greater in the latter case. Experiment also shows that the first portions of gas condensed give the greatest liberation of heat, and that this gradually diminishes as the action is continued. Each molecule of the carbon may be considered as a centre round which are grouped successively layers of solidified carbonic acid, which are more and more condensed towards the centre.

The contraction in saline solutions presents comparable results. Suppose, *e.g.*, a crystal of sulphate of soda dissolved in 10 equivalents of water, in which case the anhydrous saline molecule has a coercitive action on the water, producing contraction to the extent of about a $\frac{1}{10}$; the aqueous molecules will be condensed about the saline molecules, as the carbonic acid was condensed about the molecule of carbon.

This coercitive action is accompanied by a number of other phenomena, among which may be mentioned, ascent of the boiling- and descent of the freezing-point, and diminution of the tension of vapour emitted by the liquid.

To resume: when a salt is dissolved in water, each saline molecule tends to place itself in equilibrium with the molecules of the surrounding water, the water exercising on the salt a dissociating action, and the salt exercising on the water a coercitive action. This reciprocal influence appears in a sphere of action round each saline molecule, and there results a new equilibrium between this sphere and the rest of the solvent. All the saline molecules act similarly, and the entire equilibrium will be the resultant of the partial equilibria.

If, now, we suppose a quantity of salt, dissolved in a litre of water, to produce a contraction of 1 c.c., comparing this effect with the two previously mentioned, it may be asserted that the forces called into action are equivalent on the one hand to 7576 calories, and on the other to an increase of pressure 21·34 atmospheres. These theoretical results were closely verified by experiment with the anhydrous and hydrated salts of sulphate of sodium.

In such cases of solution the heat liberated by the contraction of the water does not all appear in the calorimeter; it is employed, in part, to melt the solid substance, and becomes latent in this change of state. Another part is employed in the reaction of the dissolved salt in the solvent, and in the special cases just referred to, absorbed by the substance dissolved. This absorption may be observed in cases where the substance dissolved is already in the liquid state, as in the case of a mixture of concentrated sulphuric or acetic acid with water. The quantity of heat liberated is much less than that which corresponds to the contraction of the solvent; whence must be inferred a retention of the difference by the substance dissolved in its reaction with the water.

This presents chemical combinations in a new light. With very rare exceptions, every phenomenon of combination is accompanied with a liberation of sensible heat, but, as has been seen, the number of calories observed does not represent the total heat produced; it is simply the difference between the heat yielded by one of the combining substances (the contracting solvent), and the heat received by the other (the substance dissolved). In most chemical combinations, the passive body receives only part of the heat disengaged, and the rest becomes free as sensible heat. In others, however (as the solution of hydrated sulphate of soda in water, or the formation of explosive compounds, like protoxide of nitrogen), the passive substance requires more heat than the active substance can yield, and then we have production of cold.

It had been remarked in a previous paper, that in various saline solutions, being sufficiently extensive and

* Read before the British Association, Brighton Meeting, Section B.

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composed in the same manner (as *e.g.*, 1 equivalent of the salt dissolved in a litre of water), each of the saline radicals increased the density of the solution by a fixed quantity, or *modulus*, which was independent of any other radical associated. Interpreting this result by the foregoing ideas, it appears that each saline radical produces in the solvent a contraction of volume which is proper to it (the radical); now this constant contraction of volume corresponds, in the case of the solvent, to a liberation of heat equally constant; hence in the formation of saline solutions, each saline radical receives from the solvent a quantity of heat which is always the same, and is independent of a second associated radical; this is its *thermal modulus*.

This result finds confirmation in the principle of the *thermoneutrality* of salts, in virtue of which different salts dissolved successively in the same quantity of water act in the same way, from a thermal point of view, as if they were dissolved separately.

Analogous conclusions are arrived at in studying saline solutions from the point of view of capillary action. It has been shown that, for such solutions, there are capillary moduli, as well as moduli of density; and that the product of the density by the capillary height, taken always in a tube of the same diameter, is nearly constant. It follows from the above that there is an intimate relation between these capillary actions and the thermal effects.

A. B. M.

ON THE

METALLURGY OF MANGANESE

AND THE

DOCIMASTIC ASSAYING OF MANGANESE ORES.

By HUGO TAMM.

THIS paper will raise much criticism; and anything of value which it may contain will be disputed, so that very little credit will be given to me who claims the laying down of the basis of the metallurgy of manganese, which, up to this day did not exist.

The names of Pliny, who described manganesia as a black magnesia, of Scheele, who recognised it as a distinct earth, and of Gahn, who isolated manganese, will be thrown at me with alacrity, and I am not quite sure that elaborate articles will not be published establishing as undeniable facts that Tubal Cain knew the use of fire, that lime, fluor-spar, and glass were known of the ancients, and that loam and plumbago are in constant use in the arts. Yet in spite of all this I will feel quite confident that, until now, the metallurgy of manganese did not exist, and that I was the first to establish it on its true basis.

I had a great many practical difficulties to overcome before I was enabled to bring it to the simple form under which I now describe it. I have rendered it almost as simple as the metallurgy of iron; so far, at least, as is consistent with the nature of manganese, a very oxidisable metal. But although I have great faith in the progress of industry, I must confess that I do not think that under present circumstances, and with the common substances at the disposal of chemists and metallurgists, the metallurgy of manganese can be simplified or improved upon.

To do the one or the other new and inexpensive materials which do not exist at present would have to be used, and I repeat that with the actual means at the disposal of industry, the metallurgy of manganese has reached in my hands the last degree of simplicity and perfection which it could attain. However others will judge. The metal obtained by the new process is not pure manganese, it is to manganese that which cast-iron is to iron, and I will henceforth call it cast-manganese. But it is prepared with common materials, and the superiority of the process consists in this, that with a given manganese ore the cast-manganese is purer than the corresponding metal extracted by another process, and lastly, it is obtained with greater facility, greater security, and at less expense than with ordinary means, and what is most important of all, it may be prepared in unlimited quantity.

If I have been thus successful in creating, so to speak, the metallurgy of manganese, it is because my endeavours were directed from the first to the reduction of manganese ores in presence of a flux. I knew this to be the knot of the question, and I was quite right.

The reason of this will be obvious after I have described the nature of the flux used for the smelting of manganese, and the nature of the slag obtained after smelting.

I will divide this paper into six parts.

(1). Preparation of the fluxes.
(2). Preparation of the crucibles.
(3). Smelting of manganese ores.
(4). Refining of cast-manganese.
(5). Properties of cast-manganese, and analyses of the ore and of the metal.
(6). Docimastic assaying of manganese ores.

Preparation of the Fluxes.—Two fluxes are required for successful and really practical operations in the smelting of manganese. One which I will call flux No. 1. or white flux, and which is obtained by mixing well together common ground bottle glass free from lead, quick-lime, and fluor-spar. The following are the exact proportions to be mixed.

Ground glass	63 parts
Quick-lime	18½ ,,
Fluor-spar	18½ ,,
	100

This flux is the original flux from which the others are made, but it is used also *per se* to add to the fusibility of the others.

The second flux, flux No. 2., or black flux, is theoretically required for the smelting of manganese, and it can be used in practice. It is formed by mixing:—

Flux No. 1. (white flux)	61½ parts
Native oxide of manganese, of good quality..	35 ,,
Very fine charcoal powder, soot, or lamp-black	3½ ,,
	100

This flux may be used just as it is obtained after mixing. But it is best to incorporate the mass by adding enough of an oil to form a thick paste, and heating the whole at a high temperature in a closed crucible. The oxide of manganese is reduced to the state of protoxide, the flux assumes a fine olive green colour. It may be ground and kept for any docimastic or metallurgical operation on manganese.

But on the whole, the best and safest mode of operating is the following. A mixture is made of:—

Flux No. 1.	34 parts
Lamp-black, or soot of good quality	5½ ,,
Peroxide of manganese, native, of good qnality	60½
	100

And it is smelted as will be hereafter described. 17½ parts of cast-manganese are obtained, and the slag which presents a fine olive green colour, is ground. It is saturated with protoxide of manganese, to which it owes its colour, and it forms an admirable flux, either for the smelting of manganese ores or for their docimastic assaying. I shall henceforth always design the flux thus prepared as flux No. 3, or green flux.

I have not made a full analysis of this flux, which might be interesting in some respects, for the reason that I expected no practical result from such an analysis, or, indeed, no theoretical considerations of real value. The

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flux contains of course all the elements of flux No. 1, *plus* a large amount of protoxide of manganese, *plus* a certain quantity of the oxide of iron and the silica and earthy matters contained in the manganese ore, and we will see, by-and-bye, how this slag, for it is nothing else but a slag, has acted during the smelting. When this flux is prepared specially for docimastic purposes, it ought to be made with the native oxide of manganese. When once the green flux has been obtained, the extraction of manganese presents no further difficulty, because it can be used over and over again providing the oxide of manganese reduced is of a tolerably good quality, and introduces no injurious material in its slag. This slag being saturated with protoxide of manganese, is as good as the original flux, and the only improvement which it requires, is the addition from time to time of a little white flux, to add to its fusibility, which might be slightly impaired by the incorporation after each smelting of the gangue of the ore.

Green flux is formed of three distinct parts; glass or dissolving agent, to which lime may be added; fluor-spar, or fluidifying agent; and protoxide of manganese and lime also, or refining agents.

I will not dwell at length on its chemical properties, but I will resume them in a few words.

(1). It becomes very fluid at a high temperature, and allows the metallic grains to collect easily in a mass.

(2). Its silicates, besides dissolving the earthy matters of the gangues, add some silicium to cast-manganese, and add to the fusibility of this metal.

(3). The silicates form with protoxide of iron a silicate irreducible by carbon.

(4). The protoxide of manganese with which it is saturated acts as a refining agent, and it prevents cast-manganese from absorbing more than a certain proportion of silicium, of carbon, of iron, or of earthy metals.

(5). Its chief property is that it does not dissolve oxide of manganese, and that it allows the whole of the oxide mixed with it to be reduced to the metallic state.

These few facts of importance once established and understood, we will proceed.

Preparation of the Crucibles.—My successful efforts in discovering a perfect flux for the reduction of manganese would have been unavailable had I not succeeded in overcoming another apparently insuperable difficulty. At the high temperature required for the smelting of manganese, no crucibles could stand the flux, and they were all destroyed. I tried pots of every description, even the best plumbago crucibles, but none would stand the molten flux.

I could not think of using pots lined with charcoal in the usual fashion, because this kind of lining is not practicable on a large scale, but the following plan which I devised is so simple and so effective that not only is every difficulty removed, but special advantages are attached to its use.

Three parts of plumbago, and 1 part of loam or fire-clay are mixed together, and made into a thick paste with water, and the crucible is as equally as possible lined with this paste, which holds firmly to its sides. The thickness of the lining varies with the size of the crucible, but with the largest crucibles it should not exceed half an inch.

The properties of this lining are worth mentioning.

(1). It stands the destroying effect of the flux to perfection.

(2). A crucible so lined may be used immediately after it is lined, providing it is gradually heated.

(3). After smelting, neither flux nor metal adhere to the lining, and both may be extracted quite easily by reversing the crucible and tapping it gently.

This last fact is very important, since both the crucible and its lining can be used several times. Still after each smelting the lining wants repairing slightly with the mixture of loom and plumbago, made into a somewhat thinner paste than at first, and the outside of the crucible *must be repaired with* a little thin fire-clay.

I think it is just as well to give these apparently tedious details, which have their importance; but should I omit anything, with a little practice the best modes of working would soon be found out. The discovery of a flux, in presence of which manganese could be reduced, and of a crucible which could stand the destroying action of the flux, were the two real difficulties to be overcome; the remainder presents nor eal difficulty.

Smelting of Manganese Ores.—The proportions which will be given are those which were found to succeed best with a manganese ore of good quality, and they do not admit of much alteration; but still the general process is of course open to slight modification, according to circumstances and to the nature of the ore used.

Any crucible which will stand a white heat for several hours without softening can be used. It is lined with loam and plumbago, as I have previously described, and then the following mixture is introduced into it:—

Native oxide of manganese of good quality	1000 parts.
Lamp-black or soot of good quality	91 „
Green flux	635 „
Oil, in sufficient quantity to merely wet the mixture.	

Any kind of oil is good enough for the purpose. The mixture must be made shortly before introducing into the crucible; for if it is left standing for some hours, especially in an open vessel, it is apt to catch fire, and is then unfitted for smelting. Should this occur, the addition to the burnt mixture of about 45 parts of lamp-black or soot and some more oil would remedy the accident. But it is only after standing for some eight hours that the mixture takes fire.

The mixture is introduced in the crucible and slightly pressed in, and a round cover of thick wood is placed over it. It is carbonised during the smelting, and forms a charcoal cover which protects admirably the mixture from oxidation, and it can be used several times.

The clay or plumbago cover is then placed over the crucible, and the joint is luted with a little thin fire-clay. A small aperture is kept to allow the gases to escape.

The crucible is then placed in a wind- or blast-furnace, and slowly heated so long as fumes escape from the crucible. The heat is then rapidly increased until it reaches white heat, and the furnace is maintained at that high temperature for several hours, the time required depending, of course, on the quantities operated upon.

When it is thought that the operation is done, the fire is allowed to burn away and the crucible is left to cool. The cover is then removed by means of a chisel introduced in the joint. The crucible is turned upside down, and shaken until the slag and metal fall down. The button of metal is detached from its slag with a hammer, and introduced in well-corked or stoppered vessels perfectly dried.

The slag, which has a fine olive-green colour, breaks up in fragments with large faces affecting a pseudo-crystalline structure, but the grain is really crystalline. It is ground and used as flux in a second smelting. It is advisable after each smelting to add to the slag, in order to make it more fusible, about 1-10th of the white flux.

The mixing of manganese ore, lamp-black, and flux is not an indifferent operation, and to ensure perfect success it should be done in the following way:—The oxide of manganese should be first of all thoroughly mixed with the lamp-black. Then this mixture should be pretty roughly mixed with the flux, and then oil should be added. By so doing, lamp-black and oxide of manganese remain united during the mixing, and act upon each other during the smelting, before the flux begins to melt, so that the oxide is reduced to the metallic state before the flux can dissolve any portion of it. The residue of carbon left by the burnt oil assists in reducing the oxide of manganese, and in preventing the flux from acting upon it before it has been reduced to the metallic state.

It is almost an extraordinary thing that, according to the

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manner in which substances have been mixed, their chemical reactions should differ; but it must be borne in mind that, in docimastic or metallurgical operations, several successive chemical reactions take place at intervals. Hence the real importance of a systematic way of mixing.

If manganese ores of very bad quality were to be used, the slag would of course, after a few operations, become unfitted for further use; but, with good manganese ore, the slag can be used over and over again, and forms an admirable manganese flux.

Very little need be added to these general considerations: the general process will undoubtedly undergo some slight alterations at the hands of those who may be tempted to use it; but the main facts established here must perforce remain the same, the more so that I have been unsuccessful in modifying them deeply. It is extremely doubtful whether any improvements will be made upon the process, chiefly because such improvements could scarcely add to the simplicity of the operation. The only real improvement of importance would be the addition to the flux of a substance which, in small quantities, would assist in obtaining a cast-manganese of a superior quality.

It is worthy of remark that, in presence of either the white or the green flux, charcoal, even in very fine powder, cannot be substituted for lamp-black or for soot. Charcoal-powder does not reduce the oxide of manganese to the metallic state, but only to that of protoxide. On the contrary, with the proportions previously given, lamp-black reduces 420 parts of manganese from 1000 parts of peroxide, or nearly the whole of the metal which it contains.

Is this difference due to the physical condition of both forms of carbon, or to their chemical constitution? Does the non-volatile carburet of hydrogen contained in soot or lamp-black exert a more powerful reducing action than carbon itself? This is very possible, but I have not studied closely this question and am not prepared to answer it.

Refining of Cast-Manganese.—There is little doubt that, as soon as manganese is prepared on the large scale and at a comparatively low price, some uses will be found for it. I think that, in certain operations, it might form a good substitute for potassium and sodium; and in that case cast-manganese, such as is obtained after the smelting of its ore, could be used with advantage; but, should a purer kind of metal be required for the manufacture of certain special alloys, cast-manganese would have to be refined.

The simplest way of refining manganese is the method which has been proposed by Berthier I believe, and which consists in re-melting the cast-mangnese coarsely powdered with about one-eighth of carbonate of manganese. The mixture is introduced into a refractory clay crucible, and covered over with a wooden cover similar to the one sed in the smelting, to prevent oxidation.

I need not make any further remarks on so simple an operation.

Properties of Cast-Manganese: Analyses of this Metal and of the Ore.—The properties of cast-manganese, of the refined metal, and of pure manganese are those which are so well known, which have been described so often, and which may be found in any treatise on chemistry. The handling of unlimited quantities of cast-manganese did not bring out any new or remarkable properties worth mentioning. The ore operated upon during the course of these investigations presented the following composition:—

Peroxide of manganese	79·50
Peroxide of iron	6·50
Water	3·50
Phosphate of lime	trace
Gangue	10·50
	100·00

It contains, consequently, 50·5 per cent of metallic manganese and 6·5 per cent of metallic iron.

The cast-manganese obtained from this ore presented the following composition:—

Manganese	96·90
Iron	1·05
Aluminium	0·10
Calcium	0·05
Phosphorus	0·05
Sulphur	0·05
Silicium	0·85
Carbon	0·95
	100·00

100 parts of the ore, containing 50 per cent of manganese, yielded from 42 to 45 per cent of cast-manganese, containing only 1 per cent of iron, while the ore itself contains 6·5 per cent of this metal.

Cast-manganese, refined by carbonate of manganese, presented the following composition:—

Manganese	99·910
Iron	0·050
Silicium	0·015
Carbon	0·025
Other substances	traces
	100·000

Docimastic Assaying of Manganese Ores.—Should works be erected for the extraction of manganese on the large scale, the docimastic assaying of manganese ores would undoubtedly offer great interest and be of great consequence. In the course of two hours at most several assays might be made, giving an accurate estimation of the amount of metal which a given ore would produce on the large scale, and enable the metallurgist to judge of the quality of the metal obtained.

The docimastic assaying of manganese ore is performed exactly as the corresponding mode of valuation of iron ores, with, however, the modifications required by the new metallurgy. Some white flux and some green flux, prepared exactly as I have described in the metallurgy of manganese, should be kept at hand with the other requisites of the metallurgy of manganese, carbonate of manganese, lamp-black, oil, and a mixture of loam and plumbago.

The experiments should be made on quantities varying from 500 to 1000 grs. of the ore, and the whole of the operations should be carried out on the small scale exactly as I have described them on the large scale, without any other modification than that of the reduction of the proportions.

I trust that my labours will be lost to neither science or industry, but that they will be the means of opening a new field of research to the one and of useful appliances to the other.

ON A

SIMPLE APPARATUS FOR THE PRODUCTION OF OZONE WITH ELECTRICITY OF HIGH TENSION.

By Professor ARTHUR W. WRIGHT.

EXPERIMENT has shown that, in the production of ozone by electricity, the maximum amount of oxygen is ozonised by the silent or glow discharge, and most of the forms of apparatus by which this is effected are contrivances by which oxygen is made to flow slowly through a space traversed by such a discharge. In Von Babo's apparatus, as well as in those of Siemens and Houzeau, the metallic conductors are separated by glass and a stratum of air. By inductive action of the charged metallic surfaces the intervening air becomes charged with electricity oppositely

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upon its two sides, and simultaneously with the discharge of the metallic terminals, through the wire of the coil, a discharge takes place through the air, not in the form of sparks, but diffusely, producing a glow of purplish light visible only in the dark.

These apparatus succeed best with electricity of comparatively low tension. In using the Holtz's electro-machine with them the discharge is apt to occur chiefly in the form of sparks through the air, or it may even traverse and perforate the glass, and the form of the apparatus must be varied to give the best results.

When the poles of the machine itself are separated to a sufficient distance, the electricity passes between them, either in the form of a diffuse brush, spanning the whole interval, or with a very minute brush upon the negative pole, and a glow upon the positive, the intermediate space not being visibly luminous. This is the so-called dark, or silent discharge, exhibiting the phenomena of the electric shadow when suitable objects are interposed, as described in a former paper.* When this occurs, the strong odour shows that a considerable amount of the atmospheric oxygen is converted into ozone.

If this discharge is made to take place in an enclosed space through which air or oxygen can be driven, the ozonising effect of the electricity is heightened and can be utilised. The apparatus which I have employed, and which has afforded very satisfactory results, consists of a straight glass tube about 20 centimetres long and having an internal diameter of 2·5 centimetres, the two ends being stopped with corks covered on the inner side with a thin coating of cement to protect them from the action of the ozone. Through the axis of each cork is inserted a glass tube of about 5 m.m. calibre and 7 centimetres in length, having a branch tube inserted perpendicularly at the middle and long enough to permit a rubber tube to be slipped upon it. The outer ends of the tubes themselves are closely stopped with corks, through which are passed straight, thick copper wires carrying suitable terminals at their inner ends, and bent into a ring at the others. They are fitted so as to make tight joints, but to allow of motion in order to vary the distance between their inner ends. One of these wires carries a small ball; the other terminates in a disc with rounded edge, set perpendicularly to the axis of the tube, and so large as to leave an annular space of some 2 or 3 millimetres breadth around it. The gas is admitted through one of the branch tubes and escapes from the other, after having passed through the whole length of the tube.

In using the apparatus, the wires must be connected with the poles of the machine in such a manner that the disc becomes the negative terminal, as this arrangement gives the greatest degree of expansion and diffuseness to the current. On turning the machine and adjusting the ball and disc to a proper distance, a nebulous aigrette surrounds the latter, quite filling the interval between it and the wall of the tube, while the part of the tube between the disc and ball is crowded with innumerable hazy streams converging upon the positive pole, or simply causing the latter to be covered with a faint glow. A current of air or oxygen sent into the tube must pass through this, and ozone is very rapidly produced, and in great quantity. The condensers are of course not used with the machine when this apparatus is employed.

There appears to be an advantage in causing the oxygen to pass from the negative toward the positive within the tube, for the gas through which the discharge passes is transported in the contrary direction, as may be readily seen on bringing a candle-flame between the poles of the machine, or causing a thin column of smoke to rise through the polar interval. The flame and the smoke are deflected, and stream off toward the negative pole. If the gas should be admitted in the direction mentioned, there would be a tendency to obstruct its flow somewhat, and thus keep it longer under the influence of the electricity.

Some experiments which were made with the apparatus will give an idea of its efficiency. 100 c.c. of water were placed in an upright tube or test-glass, and into it were put 20 drops of strong indigo solution, causing it to assume a deep blue tint. Air was driven through the ozonising tube, under a pressure of about 3 inches of water, and on issuing from it conveyed by a tube into the solution. When the electro-machine was put in operation, being turned with sufficient speed to give nearly its maximum effect, the solution completely lost its blue colour in less than four minutes. Blue litmus solution under similar circumstances became pale pink, but required a considerably longer time for the change.

When Schönbein's test solution is employed the deep blue colour is immediately produced, but the solution is too thick to work well if the starch has been heated considerably, or for a long time, in making it. A better proportion is to take 1 part of potassic iodide, by weight, 10 parts of starch, and 5000 parts of water. This forms a milky solution, sufficiently mobile to mix well when the ozonised air bubbles through it. When 100 c.c. of this solution were used, and air passed through the apparatus as before, the blue colour appeared at once on application of electricity, and in thirty seconds it was deeply coloured.

With dry oxygen the effects were much more rapid and remarkable. 100 c.c. of the solution were used, as before. The instant the machine was put in action the liquid about the end of the delivery-tube became deep blue, and in from ten to fifteen seconds the whole had acquired a uniform and intense blue colour.

The summer moisture having interfered somewhat with the effective working of the electro-machine, there has been no opportunity to determine the percentage of ozone produced in this manner, but it appears to be very large. When dry oxygen is passed through the tube very slowly, the issuing gas, when inhaled, produces a painful burning sensation in the lungs, and causes violent coughing, which persists for a considerable time.

When oxygen is used, it is found that the electrodes must be separated to a much greater distance than is necessary for air, otherwise sparks pass and destroy a large proportion of the ozone already formed. With air, the direct spark in the apparatus could not be made to pass over an interval of more than 7 centimetres, but in oxygen they did not cease until the poles were separated about 11·5 centimetres. When the tube was filled with air, and the poles were 7 or 8 centimetres apart, the discharge was of the silent kind, but on admitting oxygen it immediately took the form of direct sparks.

The quantity of the solution used in these experiments was much greater than would be needed in order to exhibit the characteristic reactions of ozone to an audience of moderate size. One-half or one-third of the amount would be quite sufficient, and the time required for the reaction would be proportionally shorter. The great quantity of the ozone, as well as the ease and rapidity with which it is produced, render the apparatus especially serviceable for use in the lecture-room.—*American Journal of Science.*

* *Am. Journ. Sci.*, II., vol. xlix., p. 381, and III., vol. i., p. 437.

ON DYES AND DYE-STUFFS OTHER THAN ANILINE.*

By Dr. F. CRACE CALVERT, F.R.S.

(Continued from p. 92).

Orchil, Cudbear, Litmus.—I shall now call your attention to a colour which was discovered in 1300, by an Italian named Federigo, who, during his travels in the East, observed the tinctorial powers of a certain class of weeds called *lichens*, and he introduced the colour into Florence under the name of *orchil*. By this discovery he and his family made a very large fortune.

* The Cantor Lectures, delivered before the Society of Arts. Revised and communicated by the Author.

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Lichens are small plants which live either in the stems or leaves of trees, or on rocks, or damp soils. To this class belongs all the vegetation found in the Arctic circle, but the species growing there are not employed to produce the colouring matter orchil, the varieties used for this purpose being found in warmer, and especially in tropical climates. These latter can be divided into two classes; the first and most abundant, which grow on rocks near the seaside, includes the species *Roccella tinctoria* and *Roccella fuciformis*. They are obtained from the Canary Islands, Cape Vere, and Sardinia, but principally from Madagascar, Zanzibar, Angola, and South America. The second class grows inland, and includes the species *Variolaria orcina*, found especially in the Pyrenées.

Lichens do not contain any colouring matter already formed, but contain colourless acids, which, under the influence of ammonia and the oxygen of the atmosphere, give rise to the orchil. As the lichens imported into this country vary considerably in the amount of orchil which they yield, Dr. Stenhouse has rendered a great service to the manufacturers in furnishing them with a simple and accurate process of ascertaining their commercial value. The following is an outline of his method:—100 grs. of the lichen are macerated with a dilute solution of caustic soda, two treatments being sufficient to extract the whole of the colouring matter. A solution of hypochlorite of sodium of known strength is added to the soda solution from a graduated alkalimeter; the moment the bleaching-liquor comes in contact with the soda solution of the lichen a blood-red colour is produced, which disappears in a minute or two, and the liquid has only a deep yellow colour. A new quantity of bleaching-liquid should then be poured into the soda solution, and the mixture carefully stirred. The operation should be repeated as long as the addition of the hypochlorite of sodium causes the production of the red colour, for this shows that the soda solution still contains unoxidised colouring principle. Towards the end of the process the bleaching-solution should be added by only a few drops at a time, the mixture being carefully stirred between each addition. By noting how many measures of the bleaching liquor have been required to destroy the colouring matter in solution, the amount of colouring principle contained in the lichen may be determined.

The manufacturers of orchil are also indebted to Dr. Stenhouse for a process of obtaining the orchil, which, besides simplifying the operations required, gives brighter colours and extracts than could be produced before the publication of his method, in 1848. Of this you will easily judge when I tell you that the process carried on for centuries consisted in breaking up the weeds in water, to which putrid urine, lime, and carbonate of soda were added from time to time. After two or three months exposure to the air, the colourless principles of the lichen became transformed into the colouring matter orchil. As the science of chemistry progressed, and cheap means of producing ammonia were devised, this compound was substituted for the urine. Dr. Stenhouse's process consists in exhausting the lichens, by macerating them with milk of lime, squeezing the liquor off, and after having repeated this treatment two or three times, he adds an acid to the liquors, when a white gelatinous precipitate is produced, which, when collected and placed in contact with ammonia, gives rise to orchil.

You are doubtless aware that the beautiful purple and mauve colours obtained on silk and wool from orchil are extremely fugitive, losing their brilliancy on exposure to the light or to the influence of weak acids, such as sulphurous, which is abundantly produced in our manufacturing districts. M. Marnas, of Lyons, succeeded in the year 1856 in making orchil colours which gave fast purples and mauves.

Before describing this valuable discovery, allow me to state that it had a most important bearing on the marked progress which the art of calico-printing has made since the date above mentioned. Until that time, neither dyers nor calico-printers would use expensive dyes, but since then, they have paid as much as £40 or £50 per pound for the solid dye-stuff, although these enormous prices have been apparently decreased by the colours being sold in the state of paste or solution.

The demand for a fast purple in this country was so great, consequent on the introduction of the fast purples and mauves on the Continent by M. Marnas, that attention was directed to the preparation of these colours. Mr. Perkin had obtained from aniline a fine purple colour, as fast as the orchil colours, and M. Béchamp discovering about this time a method of producing aniline artificially from benzine, Mr. Perkin was enabled to manufacture his colour commercially. This may be considered as the first successful step towards the introduction of the splendid and varied coal-tar colours which are now so universally admired.

Returning from this digression, let us now enter on a description of the process of M. Marnas. He treated the lichens, as suggested by Dr. Stenhouse, with milk of lime, filtered the lime liquor off, precipitated the colour-giving principle from it with hydrochloric acid, and gathered the precipitate on a filter. This precipitate was well washed, dissolved in caustic ammonia, and the ammoniacal liquor kept at a temperature of 153° to 160° for twenty to twenty-five days, when, under the influence of that temperature, the colour-giving principles of the lichens fix ammonia and oxygen, and are transformed into a new series of products. These were separated from the liquid by the addition of chloride of calcium, which caused a fine purple-lake to be deposited. This, after being washed and dried, was sold under the name of French purple.

To dye silk or wool with French purple, it is simply necessary to mix the lake with its weight of oxalic acid, boil with water, and then filter, the oxalate of lime remaining on the filter, while the colour passes through in the filtrate. This liquor is added to a slightly ammoniacal liquid in the dye-beck; all that is now necessary is to dip the silk or wool in the beck, when they will become dyed with magnificient purple or mauve.

To dye cotton, it is necessary to mordant it with albumen, or prepare it as for Turkey red, before putting it in the bath.

Robiquet was the first chemist to isolate a colourless principle from lichens susceptible of assuming a fine purple hue when brought in contact with ammonia and oxygen. This principle he named *orcine*. He obtained it by treating the *Variolaria orcina* by strong alcohol. This solution, on being allowed to cool, gives crystals, which, on being dissolved in water and allowed to crystallise, assume the form of large well-defined crystals of hydrate of orcine. By crystallisation from ether, anhydrous orcine can be obtained. Orcine gives a fine, dark red colour with perchloride of iron; but its most remarkable property is its transformation into *orcëine*. which Robiquet shows to be due to the following reaction:—

Orcine.	Ammonia.		Orcëine.	Water.
$C_7H_8O_2$	+ NH_3	+ O_2 =	$C_7H_9NO_3$	+ H_2O

Orcëine presents itself under the form of a brown powder, slightly soluble in cold water, to which it gives a red colour. It is soluble in alcohol, but insoluble in ether. It is soluble in alkalies and ammonia, to which it communicates a magnificent violet colour. It exists in commercial orchil under the form of orcëinate of ammonia.

Time will not permit me to describe the researches of Heeran and Sir R. Kane. I must therefore confine myself principally to a short description of those of Dr. Stenhouse and Dr. Schunck.

The chief merit of Dr. Schunck consists in having pointed out the connection which exists between the orcine of Robiquet, and the *erythrine* and *pseudo-*

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erythrine of Heeran, and in showing that orcine is the sole immediate colour-producing principle of the series. This he proved by his researches published in 1842, in which he treated the dried and powdered *Variolaria orcina* by ether. On evaporating this solution, there remained a residue, from which he isolated a substance which he called *lecanorine* or *lecanoric acid*. This compound crystallises in white needles, and gives a red colour with bleaching-powder, and a dark purple with perchloride of iron. It yields a similar colour when dissolved in ammonia and exposed to the atmosphere. Its most interesting property is its conversion into orcine and carbonic acid, when boiled with an aqueous solution of baryta. The reaction is :—

Lecanorine. Orcine. Carbonic acid.
$$C_8H_8O_4 = C_7H_8O_2 + CO_2$$

He found also that on boiling lecanorine with alcohol it formed an ether, which proved to be identical with the pseudoerythrine of Heeran.

Dr. Stenhouse has succeeded in extracting the important compounds to which he has given the names of *erythrite* and *orsellic acids*. The first mentioned body is a product of the decomposition of erythrine under the influence of lime-water. The erythrine splits up into carbonic acid, orcine, and erythrite, according to the following equation :—

Erythrine. Erythrite. Orcine. Carbonic acid.
$$C_{12}H_{16}O_7 + H_2O = C_4H_{10}O_4 + C_7H_8O_2 + CO_2$$

The orsellic acids were obtained, one from the South American weed, the other from the South African. The first appears to be identical in composition with lecanorine, and is capable of splitting up under the influence of baryta or lime into carbonic acid and orcine. The one from the latter appears to be composed of lecanoric acid and a substance called roccellinine. According to Schutzenberger, lecanoric acid may be made to undergo a decomposition into orselic acid, or may be further converted into orcine.

The employment of orchil is at the present day comparatively limited, but it is still used for producing browns, maroons. and other dark shades, in conjunction with other dye-stuffs. Its chief use is to top cheap indigo blues on woollen goods; this is effected by lightly dyeing the fabric with indigo (an expensive dye), and then passing it through a bath of orchil, which gives to the cloth a rich purple hue, similar in appearance to one dyed wholly with indigo.

Cudbear is a special preparation of orchil, first manufactured by Dr. Cuthbert Gordon, from whom it derives its name.

Litmus is obtained from the same lichens as those employed for producing orchil, only lime and carbonate of potash are added to the ground weed and urine; in fact, the process is very similar to that used in former times to produce orchil. After three or four weeks, a blue colour is fully developed, when it is mixed with sulphate of lime or chalk, dried, and is ready for market. The chief employment of litmus is to communicate a peculiar tint to the cheese made in Holland.

Prussian Blue.—I shall now have the pleasure of drawing your attention to one of the finest, brightest, and most permament colours known. It was discovered accidentally in 1710, by a colour manufacturer named Diesbach, of Berlin, from which it derived its name. The process by which it was produced was kept a comparative secret until 1724, when Dr. Woodward showed how the colour had become a very profitable affair, and described a process by which it could be obtained. The process has in time undergone many improvements; but I shall here confine myself to a description of it as now carried out. I shall be obliged here to enter slightly into theoretical chemistry.

Prussian blue is a combination of iron with *cyanogen*, a compound of carbon and nitrogen. There are two well defined cyanides of iron corresponding to the two oxides, the *protocyanide*, Fe.Cy. and the *sesquicyanide*, $Fe_2.Cy_3$. These two cyanides combining together in different proportions give rise to the various shades of Prussian blue found in commerce. But, strange to say, you cannot produce either of these compounds or Prussian blue by the direct combination of cyanogen with iron. Cyanogen must be first united with potassium, giving rise to cyanide of potassium, under the influence of which salt the iron combines with cyanogen, and the cyanide of iron thus formed in its turn combines with the cyanide of potassium, forming a double cyanide. There are two double cyanides of potassium and iron; the first, called ferrocyanide of potassium, or yellow prussiate of potash; the second, ferricyanide, or red prussiate of potash. The formulæ may be represented as follows :—

Yellow prussiate .. Fe.Cy.+KCy.
Red Prussiate .. .. Fe_2Cy_3+3KCy.

To produce Prussian blue from these salts, it is necessary to replace the potassium by iron. This is effected by adding a persalt of iron to the yellow prussiate or to the red prussiate, a proto-salt of iron. The iron of the iron salt replaces the potassium of the double salts, and double cyanides of iron are produced, as seen by the following formulæ :—

Yellow Prussiate. Sesquichloride of Iron.
$$3(Fe.Cy.K.Cy.) + Fe_2Cl_3 =$$
Prussian Blue. Chloride of Potassium.
$$= 3Fe.Cy.,Fe_2Cy_3 + 3K.Cl.$$

Red Prussiate. Protochloride of Iron.
$$Fe_2Cy_3K.Cy. + 3Fe.Cl. =$$
Prussian Blue. Chloride of Potassium.
$$= Fe_2Cy_3,3Fe.Cy. + 3K.Cl.$$

That this is the case can be easily demonstrated, for if you mix together a solution of persalt of iron and one of red prussiate, which contains only percyanide of iron, no Prussian blue is formed. Again, if you mix yellow prussiate of potash with protochloride of iron, you get no Prussian Blue, because, in the first case, you have no protocyanide of iron present, and, in the second, you have no percyanide.

Simple as the production of Prussian blue appears, it requires much practice to prepare it with certainty as a pigment where a given shade of blue is required. It is seldom found pure in commerce, being generally mixed with starch, chalk, or gypsum. Sometimes they are added with a view to deception, sometimes in order to produce a lighter shade of colour. The testing of a Prussian blue by chemical means is not, therefore, a true criterion of its quality. The method usually employed consists in grinding in oil equal weights of a Prussian blue of known value, and of the one to be tested, white-lead is added to each, and the intensity of the colours compared.

The best quality of Prussian blue is obtained by mixing a dilute solution of red prussiate of potash with proto-salt of iron; the second quality is made by mixing yellow prussiate of potash with pernitrate of iron, and is called *Turnbull's blue*. Cheaper qualities are made by mixing solutions of yellow prussiate and protosulphate of iron (green copperas), which produces a pale blue precipitate. This is transformed into Prussian blue by the addition of bleaching-powder, which oxidises part of the iron, and transforms the protocyanide into percyanide. For still lower qualities, alum is mixed with the iron solution previously to the prussiate being added. Alumina is by this means mixed with the blue.

Prussian blue was first obtained on silk fabrics in 1811, by a professor of chemistry at Lyons, named Raymond, in consequence of the high premium offered by the First Napoleon for the production of a fast blue, as indigo could not at that time be imported into France. His process, with slight modifications, is folllowed at the present day, although the colour is not much used, owing to the introduction of the aniline blues. It consists in dif-

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ping the silk, for several hours, in a salt of peroxide of iron, when the oxide of iron becomes fixed in the silk, which is washed and dipped in a slightly acid solution of yellow prussiate of potash. Prussian blue is thus produced on the silk, which only requires washing to be ready for market. The only improvement made in this class of dyeing has been the addition of a persalt of tin to the iron-salt.

The production of Prussian blue on cotton or woollen fibres is effected by a curious chemical reaction. At a temperature of 212° F., all acids, even the organic, such as oxalic, citric, and tartaric, as well as the acid sulphates, possess the property of decomposing the two prussiates. The potassium of the cyanide combines with oxygen of the water, and with the organic acid. The cyanogen thus liberated unites with the hydrogen of the water, forming prussic acid. The cyanide of iron liberated unites with the fibre of the cloth, and on the latter being passed into a weak solution of bichromate of potash or bleaching-powder, or if it is left exposed to the air, part of the protocyanide of iron is converted into sesquicyanide, and Prussian blue is produced. As salts of tin greatly facilitate the fixing of the prussiate on the cloth, chloride of tin is now generally mixed with the prussiate of potash. In this case prussiate of tin is produced. To this mixture tartaric or oxalic acid is added; it is then properly thickened and printed on the calico. When the design is dry, the fabric is submitted to the action of steam, and the blue is produced on the fabric. It then only requires to be passed through a bath of bichromate of potash to develop the full depth of the shade.

Ultramarine Blue is a most valuable pigment, both on account of its cheapness and the brilliancy of its colour. It is used extensively in many branches of trade—by the calico printer in pigment printing, by the paper stainer and manufacturer, the typographic and lithographic printer, by the match manufacturer, the sugar refiner, and by the house decorator. The value of the pigment depends on the fineness of the powder, and the brilliancy of its hue.

The greatest care and much experience are required in every stage of the manufacture, in purifying the substances employed, in mixing, in heating at the proper temperature, and in grinding, washing, and drying the manufactured mass. Fourteen distinct operations are required to produce it, and it would take too much time at this late hour to enter into the details of these processes. I will therefore only attempt to give you a very rough outline of the principal points of the manufacture.

The proportion of materials used may be as follows:—

White china clay, or kaolin	50 parts
Sulphate of soda	19 ,,
Sulphur	25 ,,
Charcoal	12 ,,
Carbonate of soda	28 ,,
	134

These substances are most intimately mixed together, and introduced into an earthenware crucible, which is carefully closed and heated at a temperature of about 500° F. for 12 hours. The temperature is then gradually raised till it reaches a white heat at the end of 48 hours; the fire is then removed, and the crucible allowed to cool gradually in the furnace. The mass, as taken out of the crucible, is of a beautiful bright green colour. It is ground, washed and dried, and then calcined in an open furnace, to oxidise it; but as the slightest excess of oxidation spoils the colour, the workman from time to time adds a small amount of sulphur to the mass, by this means controlling the oxidation. The green mass gradually becomes blue, and is washed and dried, when it is ready for market.

The colouring-matter of ultramarine is not well known. It is supposed to be a peculiar sulphite or hyposulphite of soda. The solid matter itself is a double silicate of soda and alumina. What is certainly worth notice is that, although we are ignorant of the true colouring matter of this pigment, we find its composition to be almost identical with that of the natural *Lapis lazuli*, which, although very costly, was employed by printers for many centuries. The following analyses will show the similarity of composition:—

	Lapis lazuli.	Ultramarine.
Silica	45·40	46·60
Alumina	31·67	23·30
Soda	9·09	21·46
Potash	*nil*	1·75
Iron	0·52	1·06
Lime	3·52	0·02
Sulphuric acid	5·89	3·08
Sulphur	0·95	1·68
Chlorine	0·42	trace
Water	0·12	*nil*
Loss	2·42	1·05
	100·00	100·00

Artificial ultramarine was discovered by a French chemist and druggist, named Guimet, who kept the process of its manufacture secret for many years.

(To be continued).

CORRESPONDENCE.

DECOMPOSITION OF SULPHURIC ACID BY HYDROGEN.

To the Editor of the Chemical News.

SIR,—In discussing a paper I read before the Chemical Section of the British Association, I incidentally mentioned that in a battery with dilute sulphuric acid for the electrolyte, zinc for positive, and carbon packed in granulated carbon for negative, I found a coalition of sulphuretted hydrogen from the carbon, which could only be produced by the partial decomposition of the sulphuric acid.

The possibility of this was strongly doubted by several members of the Section, who attributed it to the contamination of the carbon by a sulphide of iron. On the spur of the moment I forgot to reply to this, that the sulphuretted hydrogen was only evolved when the battery was in action. It is plain that if it arose from impurities in the carbon, it should equally be evolved when the battery was at rest.—I am, &c.,

H. HIGHTON.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, August 26, 1872.

This number contains the following original papers and memoirs relating to chemistry:—

Action which Charcoal and Iron Exert at Red Heat upon Carbonic Acid Gas.—Dr. J. Dumas.—In this exhaustive memoir the eminent *savant* communicates the results of a series of experiments made by him, from which the following conclusions may be drawn:—When absolutely dry carbonic acid gas is passed over charcoal entirely freed from hydrogen, and heated to cherry-red heat, the gas is con-

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verted into oxide of carbon; when there is an excess of charcoal, the whole of the carbonic acid gas is converted into oxide of carbon. The charcoal, even when strongly ignited in closed vessels energetically retains hydrogen or water, which cannot be eliminated except by exposing the charcoal for a long time to a current of chlorine gas at red heat; charcoal not so treated yields, when employed for the conversion of carbonic acid into carbonic oxide, a gas contaminated with traces of hydrogen. When a slow current of dry carbonic acid gas is passed over iron at bright red heat, a portion of the carbonic acid is converted into oxide of carbon; the bulk of the carbonic acid, however, is left unaltered.

New Propionic Studies.—I. Pierre and E. Puchot.—The authors have prepared perfectly pure propionic acid at its highest degree of concentration; its formula is then $C_6H_5O_3,HO$; boiling-point, 146·6°; sp. gr. at 0° = 1·0143. Propionate of baryta is a crystalline compound, $C_6H_5O_3,BaO,HO$. Propionate of silver is anhydrous, $C_6H_5O_3,AgO$.

Ozone and Oxygenated Water.—F. Le Blanc.—Referring to the researches of Thenard on this subject, the author reminds the Academy that, as far back as the year 1854, he arrived at similar results, which were published in the *Comptes Rendus*, 1854, vol. xxxviii., p. 444.

Industrial Application of Ozone in America—Destruction of the Empyreumatic Flavour of Whiskey; Manufacture of Vinegar.—M. Wideman.—The author states that in 1869 he established a distillery at Boston, in which ozone was successfully applied for the destruction of fusel oil and empyreumatic substances contained in raw whiskey, which, when suitably diluted with water, was rapidly converted into vinegar by means of ozone; the quantities of spirits daily operated upon were considerable.

Division of One Base between Several Acids when in Solution; Bibasic Acids.—Dr. Berthelot.—The continuation of the exhaustive monograph on this subject.

Action of Sulphate of Copper upon Normal Urine.—R. de Luna.—By adding to 4 litres of normal urine a rather concentrated solution of sulphate of copper until a blue colouration became permanent, and by filtering and evaporating upon a water-bath the liquid so treated, the author obtained three kinds of crystals, viz., (1) composed of sulphur, oxygen, hydrogen, nitrogen, and phosphorus; (2) containing the same elements, but exhibiting different reactions; (3) containing oxygen, carbon, hydrogen, nitrogen, and traces of iron; lastly, a residue has been obtained which has, in a high degree, the power of reducing salts of copper. All these substances will be the subject of further research.

Noctilucine.—Dr. T. L. Phipson.—We have received this paper from the author; it will appear in our next.

Iodide of Nitrogen.—M. Husson, jun.—This paper records the results of a series of experiments made by the author with the view of ascertaining the action of starch, gum, and albumen upon iodide of nitrogen in nascent state. The main result is the almost instantaneous decomposition of the iodide of nitrogen and formation of ammonia, according to one of the two following formulæ:—

$$2C_{12}H_{11}O_{11} + NHI_2 = NH_3H + 2C_{12}H_{10}I\,O_{11}, \text{ or}$$
$$C_{24}H_{22}O_{22} + NHI_2 = NH_3H + C_{24}H_{20}I_2O_{22}.$$

With albumen, a more complex reaction takes place, but the iodide of nitrogen is decomposed and an iodide of albumen formed.

Bulletin de la Société Chimique de Paris, Vol. xviii., No. 1, July 1, 1872.

This number contains the following original papers and memoirs:—

New Experiments on the Isomers of Trichlorhydrine.—Dr. Berthelot.—After first referring to his former experiments on this subject, the author enters into a discussion of the correctness of the experiments of Friedel and Silva as regards the formation of glycerine from a body not originally containing that substance or derived from it. It is pointed out that they started from iodide of allyl, a substance which cannot be prepared without glycerine.

Reply to the Preceding Paper.—C. Friedel and R. D. Silva.—The authors point out that Dr. Berthelot's results do not apply to this case, inasmuch as he fails to prove that there exists a difference between propylens derived from different sources.

Cellulose and Tunicine.—Dr. Berthelot.—By cellulose is now understood that series of carbohydrates, the composition of which is $(C_{12}H_{10}O_{10})n$, which are converted into glucose by dilute acids, and coloured blue by iodine after previous treatment with either concentrated acids, chloride of zinc, or other substances. These carbohydrates are chiefly distinguished from each other by the amount of their resistance to the action of acids and the oxidising action of potassa, whereby oxalic acid is formed. By tunicine is understood a variety of cellulose which is met with in the envelope of some molluscs; this substance resists the action of chemicals more than cotton or paper, and is not acted upon by fluoride of boron.

Manufacture of Superphosphates.—A. Millot,—This lengthy memoir treats exhaustively on the industrial preparation of superphosphates, and is divided into the following sections:—Use of a mixture of hydrochloric and sulphuric acids; influence of the pulverisation of the mineral phosphates on the formation of reduced phosphates; preparation of superphosphates with bolted mineral phosphates; estimation of reduced phosphate; estimation of phosphoric acid.

Bromated Combinations of Molybdenum.—A. Atterberg.—The author describes—Bromated bromide of molybdenum, $Mo_2Br_4Br_2$, a reddish-yellow coloured infusible powder, insoluble in water and acids, but soluble in alkalies; hydrate of the bromide, $Mo_2Br_4.2OH+8H_2O$, a crystalline gold-yellow coloured body, but, on being heated in a current of carbonic acid, the water is completely driven off; chloride, $Mo_2Br_4.Cl_2+3H_2O$, a yellow-coloured amorphous substance; fluoride, $Mo_2Br_4.Fl_2+3H_2O$; sulphate, $Mo_2Br_4.O_2SO_2+H_2O$; chromate—

$$Mo_2Br_4.O_2.CrO_3+2H_2O;$$

molybdate, $Mo_2Br_4.O_2.MoO_3+2H_2O$; oxalate—

$$Mo_2Br_4.O_2.C_2O_2+4H_2O;$$

phosphate—

$$\left.\begin{matrix}Mo_2Br_4O_2\\4HO\end{matrix}\right\}2PhO;$$

cyanide, $Mo_2Br_2Cy_4+8KCy$.

Constitution of Tannic Acid.—H. Schiff.—This essay is of great value; it is, however, illustrated by a series of complex formulæ, and is not well suited for abstraction.

Chemisches Centralblatt, No. 33, 1872.

This number contains the following original communications:—

Alkaloids of Isopyrum Thalictroides.—F. A. Hartsen.—The root of this plant, belonging to the *Ranunculaceæ*, a native of the Lower Pyrenees, contains, according to the author, two different alkaloids, one of which is obtained by boiling the previously cut up root with water, filtration of the decoction, evaporation to the consistency of syrup, and addition of ammonia, whereby a precipitate is formed, consisting of tannin and hydrate of alumina; this precipitate, having been dried, yields, after treatment with ether and evaporation of that fluid, an amorphous powder of a whitish-yellow colour; this is the alkaloid termed isopyrin, which yields with hydrochloric acid an amorphous salt not precipitated by chloride of ammonium. Another alkaloid is obtained from the root; after first boiling it with water, and next treating it with alcohol, the alcoholic solution is evaporated, and, to the residue, ammonia is first added, and then ether, by the evaporation of which a crystalline substance is left, which the author terms pseudo-isopyrin; the chlorine compound of this body is precipitated by chloride of ammonium from its aqueous solution. The author intends to continue his researches on these substances.

Stearopten of the Flowers of Clandestina Rectiflora.—F. A. Hartsen.—These flowers are those of a parasitical plant which lives on poplar and willow trees, more especially on the roots, and is a native of Southern France; from the buds of these flowers, the author has obtained, by treatment with ether, a stearopten, soluble in ether and alcohol, insoluble in water, and sublimable like camphor. This substance the author provisionally terms clandestinin; the researches on the nature of this body are to be continued.

No. 34, 1872.

This number contains the following original communications:—

Chloroform from Pure Methylic Alcohol.—A. Belohoubek.—The author states that when *pure* methylic alcohol is treated with bleaching-powder and distilled water, *no* chloroform is produced; the reason why commercial methylic alcohol yields chloroform is that it contains impurities in large quantity. Neither oxalate of methyl nor acetic acid yield chloroform with an aqueous solution of bleaching-powder.

Nicotin.—H. Weidl.—This alkaloid yields, with nitric acid, nicotinic acid, $C_{10}H_8N_2O_2$, a solid crystalline body, which, when heated with lime, yields pyridin, C_5H_5N. The acid is, according to the author, identical with that which Huber has obtained from nicotin by oxidation with chromic acid. While making some preliminary observations on the structure of nicotin and the acid obtained from it, the author states that nicotin may be prepared from the aldehyde of pyrotartaric acid, in the same manner as aldehydin (isomeric with collidin) from the aldehyde of crotonic acid—

$$\underbrace{2C_4H_6O}_{\text{Aldehyde of crotonic acid.}} + NH_3 = \underbrace{C_8H_{11}N}_{\text{Aldehydin.}} + 2H_2O$$

$$\underbrace{2C_5H_8O_2}_{\text{Aldehyde of pyrotartaric acid.}} + 2NH_3 = \underbrace{C_{10}H_{14}N_2}_{\text{Nicotin.}} + 4H_2O$$

Lichen Spirits.—Dr. R. Arendt.—It appears that the original Swedish discovery of utilising the mosses and lichens, so abundantly met with in Northern Europe, for the preparation of brandy and alcohol, is now largely carried on in the Russian provinces of Archangel, Pskow, Nowgorod, and others. At the late Russian Industrial Exhibition at Moscow several samples of moss spirits were exhibited by various distillers, and the quality of this brandy was generally highly approved of by foreigners, and especially Englishmen and Frenchmen. This industry is lucrative, for it yields in the more northern provinces of Russia a net revenue varying from 40 to 100 per cent.

Jahrbuch der Kaiserlich-Königlichen Geologischen Reichsanstalt, No. 2, 1872.

This number contains no original papers relating to chemistry, and the appendix, *Mineralogische Mittheilungen*, contains analyses of minerals of interest only to the Austro-Hungarian empire; we give the titles, however, of the following essays:—

Meteorites of Stannern, Constantinople, Shergotty, and Gopalpur.—G. Tschermak.

Rocks of the Caucasus.—G. Tschermak.

Microscopical Structure of the Lava of Vesuvius—September, 1871; March and April, 1872.—A. v. Inostranzeff.

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Journal für Praktische Chemie, Nos. 11 and 12 (double number), 1872.

This number contains the following original papers and memoirs:—

Contribution to our Knowledge of the Physiological Chemistry of Milk.—Dr. F. Soxhlet.—This monograph is divided into the following sections:—Relation of the alkaline phosphates to the alkaline albuminate *(Alkalialbuminat)*; reaction of milk and of other animal fluids; coagulation of milk by rennet; filtration *(Filtrirbarkeit)* of casein through porous earthenware; capability of milk of being precipitated by carbonate of soda; relation of casein and of albuminate to a caustic alkaline lye; circumpolarisation of casein and of potassa albuminate *(Kalialbuminat)*.

Chemical Investigation of the Mineral Waters at Bad Ems (Nassau, Prussia).—Dr. R. Fresenius.—The first portion of this memoir contains the record of the author's researches of the water of the source known as Das Kränchen; the temperature of this water appears to vary, and has apparently increased since 1838, when it was found by Kastner to be 26·4°R., while the author found it, on October 7, 1871, to be 28·48°R.; the sp. gr., taken at 16·9° is 1·00308; the average yield is about 2700 litres in twenty-four hours. The following substances, detected in the water, are not present in sufficient quantity to admit of being weighed:—Boracic acid, combined with soda; cæsium and rubidium, combined with sulphuric acid; fluorine, combined with calcium; a trace of nitrogen gas. This water also contains, in 1000 parts—Bicarbonate of soda, 1·979016; bicarbonate of lithia, 0·004047; bicarbonate of ammonia, 0·002352; sulphate of soda, 0·033545; chloride of sodium, 0·983129; bromide of sodium, 0·000340; iodide of sodium, 0·000022; phosphate of soda, 0·001459; sulphate of potassa, 0·036773; bicarbonate of lime, 0·216174; bicarbonate of strontia, 0·002343; bicarbonate of baryta, 0·001026; bicarbonate of magnesia, 0·206985; bicarbonate of protoxide of iron, 0·001989; bicarbonate of protoxide of manganese, 0·000173; phosphate of soda, 0·000116; silica, 0·049742; quite free *(Völligfreie)* carbonic acid, 1·039967—total of all constituents, 4·559198. At 35·86°, which is the normal temperature of the water, and at normal barometer reading, 1000 c.c. of the water contain 597·48 c.c. of quite free carbonic acid and 404·20 c.c. of semi-combined carbonic acid. Der Fürstenbrunnen—Temperature of the water, 32·3° R. = 40·4° C.; sp. gr., 1·00323; yield in twenty-four hours, 3389 litres. 1000 parts of this water contain—Bicarbonate of soda, 2·036607; bicarbonate of lithia, 0·004439; bicarbonate of ammonia, 0·02510; sulphate of soda, 0·017060; chloride of sodium, 1·011034; bromide of sodium, 0·000350; iodide of sodium, 0·000022; phosphate of soda, 0·001467; sulphate of potassa, 0·048512; bicarbonate of lime, 0·217019; bicarbonate of strontia, 0·002477; bicarbonate of baryta, 0·001030; bicarbonate of magnesia, 0·205565; bicarbonate of protoxide of iron, 0·001897; bicarbonate of protoxide of manganese, 0·000181; phosphate of alumina, 0·000117; silica, 0·049953; carbonic acid, 1·029536—total of all constituents, 4·629776. Free and semi-combined carbonic acid, together, in 1000 c.c. of the water, 1026·2 c.c., of which 599·35 c.c. are quite free CO_2. Der Kesselbrunnen—Temperature of water of this source, 37·31° R. = 46·64° C.; sp. gr. of water at 17°, 1·003028; yield in twenty-four hours, 28,800 litres. 1000 parts contain—Bicarbonate of soda, 1·989682; bicarbonate of lithia, 0·005739; bicarbonate of ammonia, 0·007104; sulphate of soda, 0·015554; chloride of sodium, 1·031306; bromide of sodium, 0·000454; iodide of sodium, 0·000035; phosphate of soda, 0·000540; sulphate of potassa, 0·043694; bicarbonate of lime, 0·219605; bicarbonate of strontia, 0·001815; bicarbonate of baryta, 0·001241; bicarbonate of magnesia, 0·182481; bicarbonate of protoxide of iron, 0·003258; bicarbonate of protoxide of manganese, 0·000330; phosphate of alumina, 0·000200; silica, 0·048540; carbonic acid (quite free), 0·930171—total, 4·4817175. 1000 c.c. of this water contain 980·8 c.c. of free and semi-combined carbonic acid, of which 553·14 c.c. are quite free. Die neue Badequelle—Temperature of the water of this source, 40·03° R. = 50·04° C.; sp. gr. at 17°, 1·00300. 1000 parts of this water contain—Bicarbonate of soda, 2·052761; bicarbonate of lithia, 0·005536; bicarbonate of ammonia, 0·008215; sulphate of soda, 0·041500; chloride of sodium, 0·927149; bromide of sodium, 0·000480; iodide of sodium, 0·000004; phosphate of soda, 0·000368; sulphate of potassa, 0·044151; bicarbonate of lime, 0·220435; bicarbonate of strontia, 0·001516; bicarbonate of baryta, 0·000981; bicarbonate of magnesia, 0·210350; bicarbonate of protoxide of iron, 0·003985; bicarbonate of protoxide of manganese, 0.000334; phosphate of alumina, 0·000209; silica, 0·047472; quite free carbonic acid, 0·746261—total, 4·311707. The quantity of carbonic acid by bulk (at 50·04° and normal barometer) amounts, in 1000 c.c. of the water, to 897·97 c.c., of which 448·5 c.c. are quite free. The substances present in unweighable quantity in the three last-mentioned sources are the same as those mentioned in the Kränchen, but the Kesselbrunnen and Neue Badequelle contain, in addition, some traces of sulphuretted hydrogen.

Some of the Gases Occluded in Braunkohlen.—Dr. H. Kolbe.—This is a preliminary notice. The author found in Bohemian braunkohlen the under-mentioned percentage quantities of gases—

	CO_2.	CO.	N.	O.
I.	89·66	1·80	8·03	0·51
II.	82·40	3·02	14·15	0·45
In earthy braunkohlen ..	83·99	1·04	14·91	0·65

Guadalcazarite, a New Mineral.—T. Petersen.—The name of this mineral is derived from Guadalcazar (Mexico). Its sp. gr. at 15° is 7·15; its composition, in 100 parts, is—Sulphur, 14·58; selenium, 1·08; mercury, 79·73; zinc, 4·23; cadmium, a trace; iron, a trace—total, 99·62. Formula, $6HgS + ZnS$.

Some Thallium Compounds.—Dr. S. M. Jörgensen.—This monograph contains a detailed description of the following substances:—Thallium-iodür iodide; cuprotetrammonium-thallium iodide; thallium protochloride-mercuric chloride; tetrethylphosphonium-thallium iodide; triethylsulphin-thallium iodide; tarconium-thallium iodide.

Asparaginic Acid, a Product of the Oxidation of Conglutin when Acted upon by Permanganate of Potassa.—Dr. R. Pott.—After first referring to his researches on conglutin (*Journ. f. Prakt. Chem.*, [2], vol. v., p. 355), the author records at length his method of operating, the result of which is that, although only in small quantity, he obtained asparaginate of copper, $C_4H_5CuNO_4$, by treating conglutin with permanganate of potassa, and combining the asparaginic acid with copper by means of the carbonate of that metal.

Chlorides of Carbon.—K. Hoch.—Only the first page of this paper is published; the paper will therefore be abstracted when complete.

Journal für Gasbeleuchtung und Wasserversorgung, No. 13, 1872.

This number only contains papers and memoirs strictly relating to gas- and water-works' engineering and management.

No. 14, 1872.

Peculiar Case of Gas-Leakage and Poisoning by Gas.—H. F. Ziegler.—This memoir, illustrated by a map exhibiting the situation of the houses, gas-mains, service-pipes, syphons, and course of a portion of a street in Hanau, contains a detailed account of a serious leakage of gas from a syphon fitted to an 8-inch main, and the infiltration of that gas through the soil, so that a person sleeping in one of the houses was nearly suffocated, but respiration was restored after several hours by the application of oxygen. Very many years ago a similar case happened at Strasburg, a full record of which has been published by the late Dr. Orfila.

La Revue Scientifique de la France et de l'Etranger, August 31, 1872.

This number contains no original papers relating to chemistry, but the lectures on general physiology are continued:—

Phenomena of Life which are common to Animals and Plants.—Dr. C. Bernard.—This portion treats at great length on animal glycogenesis.

French Association for the Advancement of Sciences.—The complete programme is here published; it comprehends the following sections:—(1) Mathematics, astronomy, and geodesy. (2) Mechanics. (3) Navigation. (4) Civil and military engineering. (5) Natural philosophy. (6) Chemistry.—Berthelot, questions of chemical philosophy; Friedel, study of some instances of isomerism in the compounds with three atoms of carbon; A. Gautier, on some new phosphorus compounds; Grimaux, on the constitution of the monobasic fatty acids; Gruner, on steel; Henninger, synthesis of orcine; Jungfleisch, conversion of tartaric into para-tartaric acid; Prat, on the diffusion of selenium; Prat, on the theory of fluorine; Prat, on the estimation of phosphates in general; Saint Loup, on a contrivance suitable for the production of ozone and for the study of its properties; Schützenberger, on phospho-platinic compounds; Arnaud-Thénard, new facts relating to oxygenated water (peroxide of hydrogen) and ozone; Wurtz, on anomalous vapour densities, and more especially the vapour of perchloride of phosphorus. (7) Meteorology and physical condition of the globe. (8) Geology and mineralogy. (9) Botany. (10) Zoology and zootechny. (11) Anthropology. (12) Medical sciences. (13) Agronomy. (14) Geography. (15) Political economy and statistics. The excursions will be seven, and will extend as far as Bidassoa on the Spanish frontier. Among the subjects on which public lectures will be held we notice the following:—Fermentation, by Pasteur; aerial navigation, by Dupuy de Lome; industry of the landes of Gascognes, by Chambrelent.

Les Mondes, August 29, 1872.

This number contains no original papers relating to chemistry; there is, however, a paper entitled—

Prehistoric Times in Belgium.—F. Plateau.—An excellent and clear *resumé* of the labours of the International Congress of Anthropology, which has just concluded its meeting at Brussels, and a full review of all that belongs to the quaternary geological period; it appears that in Belgium many interesting objects elucidating the prehistoric age of man have been found.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 237, September, 1872.

Application of Electricity to a Débrayeur (a Mechanism to Throw out of Gear).—M. Richard.—A report, illustrated by several engravings, on a contrivance by which the breaking of threads in the process of weaving may be prevented to some extent.

Practical Irrigation—Canal de Lestelle (Haute Garonne).—H. Tranié.—The great utility of irrigation of arable and meadow lands is explained in this memoir by the detailed account of a comparatively small engineering work, constructed by the author for several landed proprietors in the locality alluded to; by judiciously arranged irrigation the net revenue per hectare (2·47 acres) has been increased by £11 15s.

Relation of the Eye and the Ocular Glasses chiefly in Use in Optical Instruments; Description of an Apparatus for Testing the Ocular Glasses.—F. P. Le Roux.—An exhaustive optico-algebraical essay, illustrated by several woodcuts.

Aërostation—Directing the Course of Air-Balloons; Limits of the Problem.—Ch. Laboulaye.—An exhaustive monograph, illustrated by several engraved plates; this paper contains complete and detailed information on Dupuy de Lôme's experiments and aerostatic journeys.

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NOTES AND QUERIES.

Gum Copal.—I should feel grateful if any of your readers could inform me how to purify gum copal from the attached impurities which occur with it as imported. I have tried solution in methylated spirits and boil of turpentine, and then distillation, but the gum is imperfectly soluble in these liquids. I have also tried distillation in a current of steam, but the distillate is a soft sticky mass of a yellow colour. What is wanted is to cleanse the gum from the attached dirt, without loss of gum or alteration of properties.—C. T. Kingzett.

PATENTS.

Communicated by Messrs. Vaughan and Son, Patent Agents, 54, Chancery Lane, London, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

2323. E. Packard, jun., Ipswich, "Improvements in the manufacture of superphosphate of lime and artificial manure."—Petition recorded August 3, 1872.

2332. J. Deere, Briton Ferry, Glamorganshire, "Improvements in the manufacture of artificial fuel."—Petition recorded August 5, 1872.

2344. C. Morfit, Baltimore, Ma., U.S.A., "Improvements in the chemical treatment of mineral and other crude phosphates of lime."—Petition recorded August 7, 1872.

2357. C. Morfit, Ma., U.S.A., "An artificial substitute for 'Redonda guano,' Alta Vela, guano, and other natural phosphates of alumina, to be used in the defecation of sewage, in the manufacture of sugar from cane and beet-root juices, and in the preparation of certain chemical products, such as pure alumina, and the alkaline and earthy phosphates and aluminates."—Petition recorded August 8, 1872.

2299. J. Richardson, Brookfoot, near Brighouse, Yorks, "Improvements in the process of dyeing textile fabrics."

2403. A. M. Clark, Chancery Lane, "A new or improved medicinal compound."—A communication from C. V. Viard, Paris.—Petitions recorded August 12, 1872.

2417. F. D. Blyth, London, and A. G. Southby, New Inn, Middlesex, "Improvements in the process and apparatus for treating wood for the manufacture of pulp for paper."

2426. D. Joy, Saltburn-by-the-Sea, Yorkshire, "Improvements in the means and apparatus for purifying iron, and for removing the slag and other impurities from blast and other furnaces."—Petitions recorded August 14, 1872.

2431. T. Routledge, Ford Works, near Sunderland, "Improvements in heating fibrous substances for textile purposes, and for the manufacture of paper stock."

2434. L. D. B. Gordon, Totteridge, Herts, "Improvements in the manufacture of iron and steel."—A communication from Professor Scheerer, Freyburg, Saxony.

2443. W. R. Lake, Southampton Buildings, London, "Improvements in puddling furnaces."—A communication from G. E. Harding, New York, U.S.A.—Petitions recorded August 15, 1872.

2446. A. K. Arrott, St. Helens, Lancashire, "Improvements in the manufacture of carbonate of soda."—Petition recorded August 16, 1872.

2459. G. P. Dodge, Upper Thames Street, London, "An improved cement for the joints of pipes and other apparatus for containing or conducting steam, water, or other fluids."—Petition recorded August 17, 1872.

2487. W. Young, Magdalen Bridge, P. Brash, Leith, and A. Scott, Musselburgh, Midlothian, "Improvements in the destructive distillation of coal, shale, and other bituminous substances for the production of illuminating gas, and of oils."—Petition recorded August 21, 1872.

NOTICES TO PROCEED.

1240. H. Galm, Upsala, Sweden, "Improvements in cosmetics."

1243. S. W. Rich, Chenies Street, Middlesex, "Improvements in the manufacture of sulphates."—Petitions recorded April 25, 1872.

1699. J. T. Dann, North Brixton, Surrey, "Improvements in the manufacture of phosphorus."—A communication from G. F. Feéron, Rouen, France.—Petition recorded June 5, 1872.

2277. E. P. H. Vaughan, F.C.S., Chancery Lane, "Improvements in the treatment of phosphates of lime."—A communication from A. Striedter, Paris, France.—Petition recorded July 30, 1872.

2389. H. A. Bonneville, Paris, France, "A new or improved process of manufacturing cast-steel."—A communication from H. A. Levallois, Paris, France.—Petition recorded August 10, 1872.

PATENTS SEALED.

573. R. Elsdon, Brockham, Surrey, "Improvements in the conversion of cast-iron into steel or wrought-iron, and in the apparatus employed therein."—Dated February 22, 1872.

653. E. Powers, Coventry, Warwickshire, "Improvements in the manufacture of iron, steel, copper, and other metals."

656. J. P. R. Poch, Brussels, Belgium, "A new chemical compound for blasting purposes."—Dated March 2, 1872.

671. R. Blackburn, Exeter, Devon, "Improvements in apparatus and in means for treating sewage for agricultural purposes."—Dated March 5, 1872.

685. C. D. Abel, Southampton Buildings, Middlesex, "Improvements in the manufacture of Bessemer steel and iron, and in the production of iron castings, and in apparatus therefor."—A communication from Z. S. Durfee, New York, U.S.A.—Dated March 6, 1872.

774. W. J. Lockyer, Bristol, "Improvements in the preparation of artificial manures."—Dated March 14, 1872.

851. F. W. Gerhard, Wolverhampton, and J. Light, jun., Bradley, Staffordshire, "Improvements in the production of iron and steel."—Dated March 16, 1872.

890. R. M. Letchford and W. B. Nation, Bethnal Green, Middlesex, "Improvements in the treatment of paraffin."—Dated March 23, 1872.

1052. A. M. Clark, Chancery Lane, Middlesex, "Improvements in the manufacture of illuminating gas and in apparatus for the same."—A communication from F. M. Rouillé, Boulevart St. Martin, Paris.—Dated April 6, 1872.

1215. J. W. Gray, Billiter Street, London, "A new or improved litheidal composition to be used as a paint and for other purposes."—A communication from F. Renoz, Liège, Belgium.—Dated April 23, 1872.

1506. J. Jeyes, Plaistow, Essex, "An improved fuel."—Dated May 17, 1872.

1637. C. Moseley, Ardwick, Manchester, "A new method and means for condensing the vapours of coal-tar naphtha."—Dated May 30, 1872.

1657. D. Nicoll, St. Paul's Churchyard, London, "Improved preparations applicable to woven and other fabrics for the purpose of rendering the same uninflammable."—Dated May 31, 1872.

1679. C. W. Harrison and A. H. Harrison, High Holborn, Middlesex, "Improvements in the manufacture of gas for lighting and heating purposes, and in the apparatus employed therein."—Dated June 3, 1872.

1806. W. C. Sillar, Blackheath, Kent, R. G. Sillar, Bolton, Lancashire, and C. Rawson, St. Swithin's Lane, London, "Improvements in treating animal matters in order to deodorise and decompose the same and to make a manure therefrom."—Dated June 15, 1872.

1851. V. Van Baerle, Worms, Germany, "Improvements in the manufacture of soap or compositions for washing purposes."—Dated June 19, 1872.

1892. G. A. Dorsett, Rotherhithe, Surrey, "Improvements in obtaining anthracene from heavy oils."—Dated June 22, 1872.

1964. B. Russ, Lime Street, London, "Improvements in the manufacture of gas, and in the treatment of residues therefrom, in the means of purifying and rectifying the same; and in the combination or amalgamation of gases for the production of light and heat, and for other useful purposes, and in the machinery and apparatus to be employed therein."—Dated June 29, 1872.

2017. W. Gorman, Glasgow, N.B., "Improvements in manufacturing iron and steel, and in apparatus connected therewith, part or parts of such improvements being applicable to various kinds of furnaces, and for the production of gases for heating and illuminating purposes, and for coking, carbonising, or calcining other substances."—Dated July 4, 1872.

FOREIGN PATENTS.

FRANCE.

95029. De Rutenberg, "Applying raudanite (hydrated silica), and its sub-product to nitro-glycerine."—Dated April 25, 1872.

95043. Du Lin and Guillemare, "Converting the acid sulphate of lime of stearine candle works into manure by precipitation."—Dated April 27, 1872.

95064. Thibonville, "An antiseptic treatment of guts for the manufacture of strings for musical instruments."—Dated April 27, 1872.

95068. Beau and Commaille, "Decolouring and disinfecting oils, and especially oils extracted by sulphide of carbon.—Dated May 13, 1872.

95082. Hutchinson, "An apparatus for extracting oil, grease, and resin, from solid vegetable or other substances by chemical means, whereby the chemical agent may be recovered."—Dated April 30, 1872.

95092. Prache, "Manufacturing carbonate of soda."—Dated March 4, 1872.

BELGIUM.

30913. F. F. Rohart, "Manufacturing ammoniacal soap."—Dated July 22, 1872.

30916. A. Warner, "Improvements in the manufacture of iron and steel, and in apparatus employed therein."—Dated July 22, 1872.

30932. F. Gusgen and M. Dubois, "A chemical process called 'lithofractor.'"—Dated July 25, 1872.

30938. A. Striedter, "Improvements in the treatment of phosphate of lime."—Dated July 26, 1872.

30942. H. A. Levallois, "Steel free from oxidation."—Dated July 27, 1872.

30943. W. Weldon, "Improvements in the manufacture of chlorine."—Dated July 27, 1872.

30944. Storck and Co., "Improvements in the treatment of phosphates."—Dated July 27, 1872.

30954. W. Weldon, "Improvements in the treatment of certain mixtures of chlorine and other gases, with the view of utilising their chlorine."—Dated July 30, 1872.

30955. H. A. Hogel and H. B. Bigelow, "Improvements in manure."—Dated July 30, 1872.

30958 E. Pfaf, "A furnace for the reduction of zinc ores."—Dated July 30, 1872.

30964. G. Ville, "A process for the manufacture of acid phosphate or perphosphate of lime."—Dated August 1, 1872.

30965. J. L. Camin and L. F. A. Martel, "A process of casting and decanting metals in a vacuum."—Dated August 1, 1872.

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THE CHEMICAL NEWS.

VOL. XXVI. No. 668.

(STUDENTS' NUMBER.)

SCHOOLS OF CHEMISTRY.

EXAMINING BOARDS.*

UNIVERSITY OF LONDON.

CANDIDATES for any Degree granted by this University are required to have passed the Matriculation Examination, to which no candidate is admitted unless he has produced a certificate showing that he has completed his sixteenth year.

The Fee for this Examination is £2.

The Examination will be held on Monday, January 13th, 1873, and includes the following subjects :—

NATURAL PHILOSOPHY.*

Mechanics—

Composition and Resolution of Statical Forces.

Simple Machines (*Mechanical Powers*): Ratio of the Power to the weight in each.

Centre of Gravity.

General laws of Motion, with the chief Experiments by which they may be illustrated.

Law of the Motion of Falling Bodies.

Hydrostatics, Hydraulics, and Pneumatics—

Pressure of Liquids and Gases, its equal diffusion, and variation with the depth.

Specific Gravity, and modes of determining it.

The Barometer, the Syphon, the Common Pump and Forcing-Pump, and the Air-Pump.

Acoustics—

Nature of Sound.

Mode and Rate of Propagation of Sound.

Musical Tones.

Optics—

Laws of Reflection and Refraction.

Formation of Images by Simple Lenses.

CHEMISTRY.

Heat—its sources. Expansion. Thermometers—relations between different Scales in common use. Difference between Temperature and Quantity of Heat. Specific and Latent Heat. Calorimeters. Liquefaction. Ebullition. Evaporation. Conduction. Convection. Radiation.

Chemistry of the Non-Metallic Elements; including their compounds as enumerated below—their chief physical and chemical characters—their preparation—and their characteristic tests.

Oxygen, Hydrogen, Carbon, Nitrogen. Chlorine, Bromine, Iodine, Fluorine. Sulphur, Phosphorus, Silicon.

Combining Proportions by weight and by volume. General Nature of Acids, Bases, and Salts. Symbols and Nomenclature.

The Atmosphere—its constitution; effects of Animal and Vegetable Life upon its composition.

Combustion. Structure and Properties of Flame, Nature and Composition of ordinary Fuel.

Water. Chemical peculiarities of Natural Waters, such as rain-water, river-water, spring-water, sea-water.

Carbonic Acid. Carbonic Oxide, Oxides and Acids of Nitrogen. Ammonia. Olefiant Gas, Marsh Gas, Sulphurous and Sulphuric Acids, Sulphuretted Hydrogen. Hydrochloric Acid. Phosphoric Acid and Phosphoretted Hydrogen. Silica.

* The Questions in Natural Philosophy will be of a strictly elementary character.

BACHELOR OF SCIENCE (B.Sc.)

This degree is conferred on candidates who pass a satisfactory examination in Mathematics, Mechanical and Natural Philosophy, Botany, and Vegetable Physiology, Zoology, and Chemistry.

FIRST B.Sc. EXAMINATION.

No candidate (with the exception of such as have obtained Honours at the Matriculation Examination in the preceding January) is admitted to this examination within one academical year of the time of his passing the Matriculation Examination.

The Fee for this Examination is £5.

The examination will commence on the third Monday in July. It is conducted by means of printed papers; but the Examiners are not precluded from putting, for the purpose of ascertaining the competence of the candidates to pass, *viva voce* questions to any Candidate in the subjects in which they are appointed to examine.

The First Examination includes the following subjects :—

NATURAL PHILOSOPHY.

Heat—

Sources of Heat; conduction—convection.

Effects of Heat; expansion generally—of water—of gases and vapours; liquefaction; vaporisation; latent heat; expansive form of steam; dew-point; gases and vapours compared.

Specific Heat.

Thermometers; Pyrometers.

Heat in the Radiant state.

Electricity—

Sources of Electricity.

Static Electricity; dual character—insulation—induction—specific inductive capacity—equivalent antithetic states—disruptive discharge—convection; Electroscopes—Leyden Jar, &c.

Dynamic Electricity; Conduction—the electric current—derived currents—induction of currents; Voltaic Pile and other voltaic arrangements.

Thermo-Electricity; Electro-Thermometer.

Magnetism—

Magnets, the Earth, &c.; Induction—communication—retention—Magnetic relations of iron, steel, &c.

Electro-Magnetism—as in the spark—in conducting media—in soft iron; Magneto-Electricity; principle of Electro-magnetic and Magneto-Electric machines.

Terrestrial Magnetism.

INORGANIC CHEMISTRY.

Matter; simple and compound.

Elementary bodies classed. Metallic and Non-Metallic bodies.

Chemical combination and Mechanical Mixture. Solution.

Outlines of Crystallography. Isomorphism. Dimorphism. Allotropic conditions of matter. Chemical Affinity, Laws of Combination by weight and by volume, as deduced from the history of the individual elements. Equivalent Numbers. Equivalent Volumes. Symbolical Notation, including questions on the Unitary System. Formulæ. Nomenclature.

Chemical actions produced under the influence of Heat. Nature of Combustion. Structures and Properties of Flame. Principles of Illumination. Chemical action of Light. Photography.

Oxygen. Ozone.

Hydrogen. Water.

Nitrogen. Chemical constitution of the Atmosphere. Diffusion of Gases. The Oxides of Nitrogen; Nitric Acid. Ammonia.

Chlorine, Bromine, and Iodine. Their compounds with Oxygen and Hydrogen. Theory of Bleaching.

Fluorine and Hydrofluoric Acid.

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Sulphur, Sulphurous Acid. Manufacture and Chemical applications of Sulphuric Acid. Other Oxygen compounds of Sulphur. Sulphuretted Hydrogen.

Phosphorus. Oxygen and Hydrogen compounds of Phosphorus. Theory of Acids. Monobasic, Dibasic, and Tribasic Acids.

Carbon. Carbonic Oxide and Carbonic Acid. The principal Hydrogen compounds of Carbon. Manufacture of Coal Gas.

Silicon and Boron. Their compounds with the elements previously enumerated.

Metals. Characters of Metals as a class. Metallurgical Processes. Alloys. Classification of the Metals.

Potassium. Nitre. Gunpowder. Theory of the action of Gunpowder.

Sodium. Manufacture of Carbonate of Soda.

Barium. Strontium. Calcium. Mortars. Cements.

Magnesium. Aluminum. Glass. Porcelain.

Manganese. Iron. Composition and properties of Cast-Iron, Wrought-iron, and Steel. Chromium.

Cobalt. Nickel. Zinc. Cadium.

Lead. Manufacture of White-Lead.

Copper. Mercury. Bismuth. Tin. Arsenic. Antimony.

Silver. Gold. Platinum.

Principal compounds of the Metals with the Non-Metallic Elements. Theory of Salts.

Principles of Mineral Analysis.

Principles of Electro-Chemistry.

For the First Examinations, a knowledge of Inorganic Chemistry only is necessary.

EXAMINATION FOR HONOURS.

Candidates for Honours in Chemistry are examined in any of the following subjects, at the option of the Examiners:—

Elementary Substances and their combinations.

Electro-Chemistry.

Radiant Chemical Action.

In the Examination for Honours, the Candidate, being not more than twenty-two years of age, who most distinguishes himself in Chemistry and Natural Philosophy, will receive an Exhibition of Forty pounds per annum for the next two years.

SECOND B.Sc. EXAMINATION.

This Examination commences on the fourth Monday in October. Candidates for this Examination who have not previously taken the degree of B.A. are required either to have passed the First B.Sc. Examination at least one Academical year previously, or to have passed the First M.B. Examination in this University.

The Fee for this Examination is £5.

This Examination embraces Organic Chemistry, including the following subjects:—

Ultimate Analysis of Organic bodies. Calculation of Empirical Formulæ. Methods of controlling Empirical Formulæ. Determination of the Equivalents of organic acids and bases; examination of products of Decomposition; determination of the Vapour-density of volatile bodies.

Law of Substitution. Compound Radicals. Homologous Series.

The Chemical History of the Cyanogen group. Cyanogen. Hydrocyanic Acid. Cyanic Acid and Urea. Fulminates. Cyanuric Acid. Sulphocyanic Acid. Chlorides of Cyanogen. Uric Acid.

Amylaceous and Saccharine Substances. Fermentation. Alcohol, Wine, Beer, Bread, &c.

Homologues of Alcohol. Ethers, simple and mixed. Oxidation of Alcohol. Aldehyde and Acetic Acid, and their homologues. Anhydrides, simple and mixed. Compound Ethers.

Diatomic Alcohols and their Acids. Glycol and Oxalic Acid and their homologues.

Triatomic Alcohols. Glycerine, Fatty and Oily bodies. Saponification.

Vegetable Acids;—the principal.

Ammonia and its Derivatives. Ammonium and Ammoniacal Salts. Amides and Amines; their Classification. The chief Natural Organic Bases.

Colouring Matters. Indigo and its derivatives. Principles of Dyeing.

The chief constituents of the Vegetable organism. Cellulose, Vegetable Fibrin, Albumen, Casein, Glutin, &c.

The chief constituents of the Animal organism. Animal Fibrin, Albumen, Casein, Gelatin. Blood, Milk, Bile, Urine, &c.

Decay, Putrefaction. Destructive Distillation.

The Chemical Principles of the process of Nutrition and of Respiration in Plants and Animals.

EXAMINATION FOR HONOURS.

The Candidate, not more than twenty-three years of age, who, in the Examination for Honours, most distinguishes himself in Chemistry, will receive Fifty pounds per annum for the next two years, with the title of University Scholar.

DOCTOR OF SCIENCE (D.Sc.).

This Examination is held within the first twenty-one days of June, and occupies four days.

No Candidate is admitted to the Examination for the Degree of D.Sc. until after the expiration of two Academical years from the time of his obtaining the Degree of B.Sc. in this University.

Candidates for the Degree of D.Sc. in any year, must give notice of their intention to the Registar, and pay to him a Fee of Ten pounds, on or before the 1st of April.

Chemical Candidates can be examined either in Inorganic or Organic Chemistry; but no Candidate will be approved by the Examiners unless he has shown a thorough practical knowledge* of the *Principal Subject*, and a general acquaintance with the *Subsidiary Subject*, or *Subjects*, specified as belonging to the Branch so selected.

Inorganic Chemistry.

Principal Subject—Inorganic Chemistry.

Subsidiary Subjects—Either Organic Chemistry; or, Mineralogy, Crystallography, and Chemical Technology in its relations to Inorganic Chemistry.

Organic Chemistry.

Principal Subject—Organic Chemistry.

Subsidiary Subjects—Either Inorganic Chemistry; or, Chemical Technology, in its relations to Organic Chemistry, and the Chemistry of Animal and Vegetable Life.

EXAMINATIONS IN CONNECTION WITH THE DEPARTMENT OF SCIENCE AND ART, SOUTH KENSINGTON.

A sum of money is voted annually by Parliament for scientific instruction in the United Kingdom.

This sum is administered by the Science and Art Department.

The object of the grant is to promote instruction in Science, especially among the Industrial classes, by affording a limited and partial aid or stimulus towards the founding and maintenance of Science schools and classes.

The following are among the Sciences towards instruction in which aid is given:—Acoustics, Light, Heat, Magnetism, and Electricity, Inorganic Chemistry, Organic Chemistry, Geology, Mineralogy, Mining, Metallurgy.

The assistance granted by the Science and Art Department is in the form of—1. Public Examinations, in which Queen's Medals and Queen's Prizes are awarded, held at all places complying with certain conditions. 2. Payments on results to teachers. 3. Scholarships and Exhibitions. 4. Building Grants. 5. Grants towards the purchase of apparatus, &c.

* It must be understood that the candidate for the Degree of D.Sc. is expected to be so fully conversant with the principal subject he may select, as to be able to go through any examinational test (whether theoretical or practical) of his acquirements in it that can be fairly applied.

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CHEMICAL LECTURES AND LABORATORY INSTRUCTION.

UNIVERSITY COLLEGE.

FACULTY OF SCIENCE.

Dean.—Professor J. B. Sanderson, M.D., F.R.S.

Vice-Dean.—Professor A. W. Williamson, Ph.D., F.R.S.

The Session begins on Wednesday, the 2nd of October, and ends on Friday, the 20th of June.

It is divided into three Terms, as follows:—Michaelmas term, from October 2nd until December 14th; Lent term, from January 6th, 1873, till March 18th; Summer term, for Lectures, from March 19th till June 11th, all inclusive.

Chemistry.—Professor Williamson, Ph.D., F.R.S.

A. GENERAL COURSE.

Lectures daily, except Saturday, from 11 to 12 a.m., up to the last week in March.

Exercises on Tuesdays, Wednesdays, Thursdays, and Fridays, from 9 to 10 a.m.

Fee for the Whole Course of Lectures, £7 7s.; for the First or Second Half Course, separately, £4 4s.; for the Second Half when the First has been taken, £3 3s.; Perpetual, £9 9s.; for the Organic Course alone, £2 2s.

Fee for the Exercise-Class—For the Course, £2 2s.; for the Half Course, £1 1s.

The Instruction in this Class is of two kinds, consisting partly of Experimental Lectures by the Professor, partly of Exercises and personal instruction on the subject of the Lectures by Tutors, under the direction of the Professor.

Students cannot profit duly by attendance on the Lectures, unless they work at the subject of each Lecture so as to make it their own.

Attendance on the tutorial part of the Class enables Students to do their work more effectually and rapidly than they can do it by themselves.

The First Half of the Course to Christmas includes those parts of Chemistry which are required for the Matriculation Examination of the University of London.

The Second Half of the Course, from January to March, includes the following subjects:—

I. Preparation and properties of the chief metals, including their characteristic reactions and most important salts. Detection of Metallic Poisons. Quantitative Estimation of Metals. Principles of Classification. Monatomic, Diatomic Metals, &c.

A weekly *viva voce* examination is held during the First Half Course and the commencement of the second Half Course.

Organic Chemistry.

This commences in the second week in February, and occupies Five Lectures weekly till about the end of March. It includes a study of the characteristics and metamorphoses of the chief organic acids, bases, alcohols, ethers, colouring matters, &c. Methods of ultimate and proximate analysis. Determination of molecular weights. Theory of types; of compound radicals. Phenomena of fermentation, &c.

Teachers of Chemistry are trained in the theory and practice of their profession. A two years' Course is absolutely requisite for this purpose; but Students will with advantage devote a longer period to it.

The first year is occupied with attendance on the Courses of Chemistry and of Analytical Chemistry. In the second year the Student again attends the Course of Chemistry, and is entrusted with teaching work in conjunction with the Tutors of the Class. At the same time he continues to work in the Laboratory at analysis and original research.

In order to qualify themselves for rising to the higher ranks of the Profession, gentlemen remain for a further period, in which case they may obtain remunerative work in teaching through the recommendation of the Professor.

It must not, however, be supposed that a study of Chemistry alone, however complete, is sufficient to qualify a man to teach the Science effectively. A competent knowledge of Physics, Mathematics, and either French or German must necessarily be acquired at some period of his Student's Course.

B. ANALYTICAL AND PRACTICAL CHEMISTRY.

I. BIRKBECK LABORATORY.

The instruction in the Laboratory is intended for beginners as well as for more advanced students. It includes practice in the construction and use of apparatus for preparing the common gases, acids, bases, salts, &c.; study of the qualitative methods of detecting and separating mineral or organic bodies from one another; also quantitative analysis in the wet way, organic analysis, vapour-densities, &c.; instruction in gas analysis.

More advanced Students are instructed in the methods of original research, especially in organic chemistry.

When accompanied or preceded by attendance on the Lectures on Chemistry, the Laboratory Course qualifies Students in the application of Chemistry to the Manufacturing Arts, Metallurgy, Medicine, or Agriculture, &c. Instruction is given in the principles and processes of Gas Analysis.

The Laboratory and Offices are fitted up completely with the most improved apparatus and utensils for experimental research, both for beginners and for advanced Students. They are open daily, from 9 a.m. to 4 p.m., from the 4th of October until the end of July, with a short recess at Christmas and at Easter. Saturday, from 9 to 2.

Fees for the Session, 25 guineas; six months, 18 guineas; three months, 10 guineas; one month, 4 guineas; exclusive of the expense of materials. A deduction of about 40 per cent is made for students who can attend only three fixed days per week.

A Gold Medal and Certificates of Honour are competed for by Students entered for the Session.

II. SUMMER COURSES.

I. *Elementary Course.*

About Forty Lessons, of one hour each, on Tuesday, Wednesday, Thursday, and Friday, from 11 to 12, commencing in the first week of May. Students are taught the construction and use of apparatus for the preparation of the most important gases, acids, &c. The characteristic tests for the presence of the common acids and bases, including the chief metallic and other poisons. Also the processes for separating these bodies from one another.

Solutions are frequently given in the class for investigation.

The first six weeks of the Course are occupied by the study of the chief non-metallic elements, and their simple compounds. Metallic salts, &c., are subsequently studied.

Fee, including the cost of materials and apparatus, for the Course, £4 4s.; Perpetual, £7 7s.

II. *Senior Course.*

This Course consists of Twenty Lessons, of two hours each, on Mondays and Saturdays, from 10 to 12, commencing in the first week in May.

The First Half of the Course includes tests for fixed and volatile organic acids, nitrogenised acids, sugars, glycerine, alkaloids, &c.

The Second Half of the Course includes tests for mineral poisons in organic mixtures; also tests for organic bodies, such as the alkaloids, when mixed with other organic substances.

Volumetric methods of the quantitative analysis of sugar and urea, chlorides, phosphates, hardness of water, alkalimetry, are practised.

Analysis of milk and of ashes of blood.

Fee, including cost of materials and apparatus, for the Course, £4 4s.; Perpetual, £7 7s.

C. SUMMER MATRICULATION COURSE.

Professor Williamson, F.R.S., assisted by Charles Graham, D.Sc.

This Course includes those parts of Chemistry whi

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are required for the Matriculation Examination of the University of London.

The Course consists of about Twenty Lessons in Practical Chemistry, and of an equal number of Oral Lessons. The Practical Lessons include the preparation of the common gases and acids, &c., and the study of their characteristic properties in relation to the elementary laws of combination.

The other Lessons are chiefly devoted to those parts of the subject which require fuller oral explanation than is given in the Practical Lessons. They include numerous exercises and questions, to which answers in writing are given by the Students. These Lessons will begin on Tuesday, April 8th, 1873, at 11 a.m.

The Class will meet on Tuesdays, Wednesdays, Thursdays, and Fridays, from 11 to 12; and some other meetings will be announced when the Class has assembled.

Fee, including cost of materials and apparatus, £4 4s.

ROYAL SCHOOL OF MINES AND COLLEGE OF CHEMISTRY.

The Lords of the Committee of Council on Education having decided to transfer the instruction in Physics, Chemistry, and Natural History from the Royal School of Mines, in Jermyn Street, and the College of Chemistry, in Oxford Street, to the New Buildings, in Exhibition Road, South Kensington, the Courses of Lectures and Practical Laboratory Instruction will in future be given at South Kensington.

Professor of Chemistry.—Dr. E. Frankland, F.R.S.

The instruction in Chemical Science embraces:—

(1). A Course of Lectures on Experimental Chemistry, with special reference to the applications of Chemistry in the Arts and Manufactures.

(2). A systematic Laboratory Course for the Practice of Chemical Analysis.

(3). An advanced Laboratory Course for technical applications of Chemical Analysis and for Chemical Research.

Chemical Lectures.—The Course consists of Forty Lectures on Mineral Chemistry and Thirty Lectures on Organic Chemistry.

Chemical Laboratories.—The Laboratories for instruction in chemical manipulation, in qualitative and quantitative analysis, the technical application of analysis, and in the method of performing chemical researches, are under the direction of Dr. Frankland, and will be opened on Monday, the 1st of October, 1872. The Laboratories at South Kensington Museum are now used for the instruction of the pupils of the Royal School of Mines.

There are three terms in the collegiate year, of three months each, commencing in the first week of October, January, and April, respectively. The Laboratory hours are from 10 a.m. to 5 p.m., with the exception of Saturdays, when the Laboratory closes at 2 o'clock.

Each Laboratory Student works independently, there being no classes. All operations are superintended by the Professor and his assistants. A table with drawers, cupboards, and shelves is appropriated to every pupil. The Institution supplies gas, fuel, and reagents. The larger and more expensive instruments of the Laboratory, such as air-pumps, thermometers, barometers, condensers, &c., may be used by the students, who are responsible for their safety. The students have to provide themselves only with the apparatus specified in the Laboratory regulations. More advanced students engaged in private researches have to supply themselves with such materials as are not included amongst the ordinary reagents of the Laboratory.

The charge for instruction in the Chemical Laboratory is £12 for three months, £9 for two months, and £5 for one month. This charge does not include the fees for attending the Lectures.

Professor of Metallurgy.—Dr. Percy, F.R.S.

The course of instruction in Metallurgy consists of Lectures and Laboratory Practice, especially in Assaying. The object of the Lectures is the communication of such instruction as the student may be able to apply to the greatest practical advantage when he may be subsequently engaged in conducting any metallurgical process.

Metallurgical Laboratory.—This Laboratory is conducted by Mr. R. Smith, under the direction of Dr. Percy, and is devoted to practical instruction in Metallurgy, especially in Assaying. The nature of this instruction will be adapted to the special requirements of the student. It comprises:—Assaying in all its branches, especially of the more important metals, such as iron, copper, lead, tin, alloys of silver and gold, &c.; and the examination of ores and metallurgical products.

The ability of the student to make trustworthy assays is in every case thoroughly tested; and no certificate of competency is given to a student who has not furnished satisfactory proof that he is able to obtain accurate results.

There are three terms in the collegiate year, of three months each. The Laboratory hours are from 10 to 4 during November, December, January, and February; and from 10 to 5 during the other months, with the exception of Saturdays, when the Laboratory is closed.

The charge for instruction in the Metallurgical Laboratory is £15 for three months, £12 for two months, and £7 for one month.

Lectures to Working Men.—Short Courses of Lectures at suitable periods of the year are given in the evening to Working Men. These courses are systematic, and arranged so as to illustrate, within a period of two years, the principal subjects taught at the Institution. Those for the ensuing Session include Natural History, Geology, and Mineralogy.

KING'S COLLEGE.

Professor of Chemistry and Practical Chemistry—C. L. Bloxam, F.C.S.

Demonstrator.—W. N. Hartley, F.C.S.

Assistant ditto.—J. M. Thompson, F.C.S.

The Session commences on the 1st of October. Students of the first and second years are admitted to the Course of Theoretical and Applied Chemistry. The Course commences with a view of the forces which concur to the production of Chemical Phenomena, after which the laws of Chemical Attraction are discussed, and the Non-Metallic Elements and their principal compounds are described.

The metals and their principal compounds are next examined, care being taken to point out the applications of the Science to the Arts, and the processes of the different Manufactures of Metallurgy, and of Domestic Economy, are explained and illustrated.

Examinations of the Class, both *viva voce* and by written papers, are held at intervals during the Course, at the usual Lecture hour.

Third Year.—Students who have completed six Terms in this Department are admitted to a course of Practical Chemistry, consisting of Twelve Demonstrations in each term; and they go through a course of Manipulation in the most important operations of Chemistry, including the first steps of Analysis.

Any Student of this Department may be admitted to this Class at any period of his study, on payment of an extra fee.

Analytical and Experimental Chemistry.—Besides the Course of Chemical Lectures and the Summer Class of Practical Chemistry, provision is made for those Students who wish to become more minutely acquainted with the practical details of the Science. By means of this Class each Student is enabled to familiarise himself with the methods of analysis and research. After passing through a preliminary course of analytical operations, each Student devotes himself to such portions of the science as are most interesting to himself, or most likely to be practically useful to him. The Daniel Scholarship of £20, tenable for two years, is given every alternate year for original research in the Laboratory.

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The Fees for admission to the Laboratory Class, exclusive of materials, are, for one month, £4 4s.; for three months, £10 10s.; for six months, £18 18s., &c.

EVENING CLASSES.

Classes for Evening Instruction are held at King's College from October to March, and during April, May, and June.

The Classes include one for the Elements of Chemistry and one for Practical Chemistry.

The fee for the former is £1 11s. 6d.; for the latter, £2 2s. The classes meet twice a week.

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN.

17, BLOOMSBURY SQUARE, W.C.

School of Pharmacy. The Session commences on October 1st, and extends to the end of July.

LECTURES ON CHEMISTRY AND PHARMACY, BY DR. REDWOOD.

These Lectures will be delivered on Monday, Tuesday, and Wednesday mornings, at 9 o'clock.

Part 1.—Physics in relation to Chemistry and Pharmacy.
" 2.—Chemistry of Inorganic Bodies.
" 3.—Chemistry of Organic Bodies.

Also Lectures on Botany and Materia Medica, by Professor Bentley. The first and second parts of this course, extending over the winter months, will be delivered at 17, Bloomsbury Square, on Friday and Saturday mornings, at 9 a.m. The third part of the course, on Systematic Botany, will be delivered at the Royal Botanic Gardens, Regent's Park, at 8 a.m.

Fees.—For registered apprentices and Associates of the Society, for either of the above courses, £1 1s.; for either part separately, 10s. 6d. For those not connected with the Society, £2 2s. for either of the above courses; £1 1s. for either part separately. Students have free admission to the Library and Museum.

Laboratory.—The suite of Laboratories for Practical Instruction in General and Pharmaceutical Chemistry will be opened on October 1st, under the direction of Professor Attfield, Ph.D. Fee for the entire Session of ten months, Twenty-five Guineas. The Laboratories are open from 9.30 a.m. till 5 p.m. Students can enter at any period during the Session.

Two Scholarships (the Jacob Bell Memorial Scholarship) of Thirty Pounds a year each, are open to competition annually in July.

The Board of Examiners meet monthly, and are required by the Pharmacy Act to examine "all candidates who may present themselves for examination in their knowledge of the Latin Language, in Botany, in Materia Medica, in Pharmaceutical and General Chemistry, and to grant Certificates of Competency."

CITY OF LONDON COLLEGE, LEADENHALL STREET, E.C.

The Annual Courses consist of three terms, each averaging ten Experimental Lectures. Fee, 5s. per term.

Subjects:—Junior Class, Chemistry—First year, Non-Metals; second year, Metals and (time permitting) Elements of Organic Chemistry. Senior Class, 7 to 8 p.m., Practical Analysis.

BIRKBECK LITERARY AND SCIENTIFIC INSTITUTION.

EVENING CLASSES.

Inorganic Chemistry—Mr. G. Chaloner. Tuesday, 8 to 9.
Practical Chemistry and Analysis—From 8 to 10, Saturday evenings.

ISLINGTON SCHOOL OF SCIENCE, WINDSOR STREET, ESSEX ROAD, N.

Evening Classes for Experimental Physics and Chemistry, with Laboratory practice on Wednesday and Friday evenings. Fee 5s. per course of Thirty Lessons. Teacher, Mr. J. Howard.

LADIES MEDICAL COLLEGE.

The Ladies' Medical College, established by the Female Medical Society in order to teach to educated women the theory and practice of Midwifery and the accessory branches of medicine.

President.—Lord Shaftesbury. *Hon. Sec.*—Dr. James Edmunds.

Elementary Chemistry.—Lecturer, Mr. J. A. R. Newlands.

Fee for two Sessions' attendance upon the Lectures on Midwifery, Anatomy, Physiology, Medical Science, and Hygiene, £10 10s. Fee for each of the extra Courses, one Session, £1 1s.; two Sessions, £1 11s. 6d.

Further details as to the objects and operations of the Society, and prospectuses of the College, may be obtained by letter to the Lady Secretary, 164, Great Portland Street, W.; or from the Hon. Sec., 4, Fitzroy Square, W.

ROYAL POLYTECHNIC INSTITUTION.

309, REGENT STREET, W.

Classes and Course of Study in Chemistry and Experimental Sciences, Steam, Electricity, Galvanism, Light, Heat, &c., under the direction of E. V. Gardner, F.E.S., M.S.A., Professor of Chemistry to the Institution.

The Chemical Laboratory is open Mornings and Evenings throughout the year. The Assay Laboratory with its complete range of furnaces will be at the convenience of Pupils who study Metallurgy.

ROYAL VETERINARY COLLEGE, CAMDEN TOWN.

Chemical Professor.—Mr. R. V. Tuson.

LECTURES AT LONDON MEDICAL SCHOOLS.

ST. BARTHOLOMEW'S HOSPITAL & MEDICAL COLLEGE.

WINTER SESSION.

Lecturer.—Dr. W. J. Russell, F.R.S. Monday, Wednesday, and Friday, at 10 a.m. One course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. W. J. Russell, F.R.S. Monday, Tuesday, and Friday, at 11 a.m. One course, £2 2s.

CHARING CROSS HOSPITAL AND COLLEGE.

WINTER SESSION.

Lecturer.—Mr. C. W. Heaton, F.C.S. Monday, Thursday, and Friday, at 11. One session, £5 5s.

The Laboratory is open daily.

SUMMER SESSION.

Practical Chemistry.—Mr. Heaton, F.C.S. Monday and Friday. One session £2 2s.

Special Evening Classes. Advanced Chemistry, Tuesday and Thursday, at 7 p.m. Fee, £2 2s. per month.

ST. GEORGE'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. H. M. Noad, F.R.S. Tuesday, Thursday, and Saturday, at 11.30. One course, £6 6s.

SUMMER SESSION.

Practical Chemistry.—Dr. Noad, F.R.S., Monday, Wednesday, Thursday, Friday, at 10. One course, including the use of apparatus and materials, £4 4s.

GUY'S HOSPITAL.

WINTER SESSION.

Lecturers.—Dr. Debus, F.R.S., and Dr. Stevenson. Tuesday, Thursday, and Saturday, at 11. One course, £4 4s.

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SUMMER SESSION.

Practical Chemistry.—Dr. Debus, F.R.S. Monday, Wednesday, and Friday, from 10 to 1. One course, £4 4s.

Practical Instruction is also given in the Laboratory by Drs. Debus and Stevenson during the Winter Session.

The Course of Lectures on Experimental Philosophy (Heat, Electricity, Magnetism, and Electro-Magnetism) is given on Wednesdays at 12 noon by Mr. G. Farrer Rodwell, F.C.S.

LONDON HOSPITAL.

Lecturers on Chemistry.—Henry Letheby, M.B., and C. Meymott Tidy, M.B. Monday, Wednesday, and Friday, at 10.30 a.m.

Practical Chemistry.—Dr. Letheby, M.B. Monday, Tuesday, and Saturday, at 9 a.m.

ST. MARY'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. C. R. A. Wright, F.C.S. Monday, Tuesday, Thursday, and Friday, at 10.15. £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. C. R. A. Wright, F.C.S. Tuesday and Thursday, at 11.30 a.m.; and Saturday, at 9 a.m. One Session, £3 3s.

MIDDLESEX HOSPITAL.

WINTER SESSION.

Lecturer.—Mr. Heisch. Monday, Tuesday, Friday, and Saturday, at 11. One session, £6 6s.

SUMMER SESSION.

Practical Chemistry.—Mr. Heisch. Monday, Wednesday, and Friday, at 11. One session, £3 3s.

ST. THOMAS'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. A. J. Bernays. Wednesday, Thursday, and Friday, at 9. One course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. A. J. Bernays. Tuesday and Thursday, 10 to 12; Friday, 11; Saturday, 10 to 1. One course, £3 3s.

WESTMINSTER HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. A. Dnpré, F.C.S. Tuesday and Thursday, at 3 p.m.; Friday, at 3.30 p.m. One course, £5.

SUMMER SESSION.

Practical Chemistry.—Dr. A. Dupré, F.C.S. Tuesday and Thursday, at 10 a.m. One course, £2.

TEACHERS OF CHEMISTRY IN LONDON.

Mr. J. C. Braithwaite.—54, Kentish Town Road, N.W. Chemistry and Toxicology, Monday and Thursday; Latin, Tuesday and Friday; Botany and Materia Medica, Wednesday and Saturday. All the classes commence at 8 p.m. Laboratory and Botanic Garden open daily, except Saturdays.

Mr. E. V. Gardner, F.E.S.—Berners College of Chemistry, 44, Berners Street, W. The course of study in each instance is directed to the express want of the pupil, or according to choice. A course embraces thirty or thirty-five Lectures, of a practical character, of about one and a half hours' duration. The usual practice of a Laboratory can be obtained, with every convenience, under the immediate direction and guidance of Professor E. V. Gardner.

Mr. Henry Matthews, F.C.S.—Laboratory, 60, Gower Street, Bedford Square. Instruction in all branches of Practical Chemistry, particularly in its application to Medicine, Agriculture, and Commerce. Laboratory open daily, except Saturday, from 10 to 5; on Saturday, from 10 to 1.

Dr. John Muter, F.C.S.—Laboratory, 231 and 235, Kennington Road. Prepares for examination of Pharmaceutical Society. Lecture hours for Session 1872-3:—Chemistry (Elementary), 10 a.m.; Botany (Structural), 11 a.m.; Chemistry (Advanced), 2 p.m.; Botany (Systematic), 3 p.m.; Materia Medica, 4 p.m.; Pharmacy, 2 p.m.; Latin, 9 a.m. and 4 p.m.; Practical Chemistry, from 10 to 4 daily. Museum of Specimens open from 12 to 1, and 4 to 5 daily.

Mr. John Newlands, F.C.S.—Laboratory, 13, Knowle Road, Brixton, S.W. Gives practical instruction in Analysis, and prepares gentlemen for various public examinations.

Mr. A. Vacher.—20, Great Marlborough Street, Regent Street.

UNIVERSITY OF OXFORD.

Professor of Chemistry.—Dr. Odling, F.R.S.

Demonstrator.—E. Madan, M.A.

A commodious Laboratory is attached to the New Museum.

Scholarships of about the value of £75 are obtainable at Christ Church, Magdalen, and other Colleges, by competitive examination in Natural Science.

UNIVERSITY OF CAMBRIDGE.

Professor of Chemistry.—G. D. Liveing, M.A.

MICHAELMAS TERM.

Chemistry, by the Professor, on Mondays, Wednesdays, and Fridays, at 12.

Practical Chemistry, by the Professor, on Mondays, Wednesdays, and Fridays, at 1 p.m.

LENT TERM.

Chemistry, by the Professor, on Mondays, Wednesdays, and Fridays, at 12.

Practical Chemistry, on the same days, at 1 p.m.

EASTER TERM.

Special Departments of Chemistry, by the Professor, on Mondays, Wednesdays, and Fridays, at 12.

Practical Chemistry, on the same days, at 1 p.m.

The Chemical Laboratory of the University is open daily, from 10 a.m. till 6 p.m.; so that Students can work there at such times as may be convenient to them; and the Professor will attend to give instruction at the times above specified. The Demonstrator of Chemistry (Mr. Hicks) attends daily for the same purpose, alternately in the morning and afternoon.

PROVINCIAL SCHOOLS.

BIRMINGHAM.—MIDLAND INSTITUTE.

Lecturer on Chemistry.—Mr. C. J. Woodward, B.Sc. Tuesday and Thursday, at 8 p.m.

Practical Chemistry.—Mr. C. J. Woodward, B.Sc. Saturday, 3 to 6, and 6.30 to 9.30 p.m.

BIRMINGHAM.—QUEEN'S COLLEGE.

WINTER SESSION.

Professor of Chemistry.—Alfred Hill, M.D., Borough Analyst. Tuesday, Thursday, and Friday, at 12.

SUMMER SESSION.

Practical Chemistry.—Professor A. Anderson. Thursday and Friday, at 2 p.m.

BRISTOL.—BRISTOL MEDICAL SCHOOL.

WINTER SESSION.

Lecturer.—Mr. Thomas Coomber, F.C.S. Monday, Tuesday, Wednesday, and Thursday, at 8.15. One Course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Mr. T. Coomber, F.C.S. Daily, except Saturday, at 8 a.m. One Course, £3 3s.

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ROYAL AGRICULTURAL COLLEGE, CIRENCESTER.

CHEMICAL DEPARTMENT.

Professor.—A. H. Church, M.A. Oxon.
Assistant.—E. Kinch, F.C.S.

The Autumn Session commenced on the 14th of August; it divides on the 6th of October, and terminates about the 20th of December.

The Chemical Instruction comprises Three Courses of Lectures and Laboratory Practice:—

(1). 32 Lectures on Inorganic Chemistry.
(2). 32 Lectures on Organic Chemistry.
(3). 24 Lectures on Agricultural Chemistry.
(4). 32 Lessons on Chemical Manipulation.
(5). 32 Lessons on Qualitative Analysis.
(6). 32 (or more) Lessons on Quantitative Analysis.

Catechetical Lectures are also given, while analyses of manures, oil-cakes, minerals, soils, waters, &c., are daily performed in the College Laboratories, and Chemico-Agricultural researches undertaken by the more advanced Students, under the immediate direction of Professor Church.

The text-books used are Church's "Laboratory Guide," Roscoe's "Chemistry," and Church and Dyer's edition of "How Crops Grow."

LIVERPOOL ROYAL INFIRMARY SCHOOL OF MEDICINE.

Lecturer on Chemistry and Toxicology,—Dr. J. Campbell Brown.

Course of 100 Lectures. Monday, Tuesday, Thursday, and Friday, at 10.15. £5 5s.

Technological and other non-Medical Students may take out any of the divisions separately—Fee, £1 1s., but no certificates will be given until the whole course has been attended.

Practical Chemistry.—It is expected that the new Laboratories will be open in November for the reception of Students, when those who desire to prosecute practical Chemistry, analysis, or original research, will be provided each with a separate working bench and cupboard, with tests, fuel, water, and gas. Fees, from £2 2s. to £10 10s. per quarter.

Summer Practical Chemistry Course. Fee £3 3s.

A Class for the Practical study of Organic Chemistry will be formed during either the Winter or Summer Session—Fee, £3 3s., including materials and apparatus.

Gentlemen who are not Students of the School are also admitted to the Laboratory and Lectures.

The Laboratory is open daily from 10 to 4 (except Saturday), for the study of Practical Chemistry, and for Analysis.

ANALYTICAL LABORATORY AND SCHOOL OF TECHNICAL CHEMISTRY.

7 and 9, HACKIN'S HEY, LIVERPOOL.

Conducted by Mr. A. Norman Tate.

A limited number only of pupils received. Hours of attendance, 9.30 a.m. to 5 p.m. (Saturdays, 9.30 a.m. to 1 p.m.). Pupils may enter at any time and for any term.

Fees—Three months, £15 15s.; six months, £26 6s.; twelve months, £52 10s.

The Laboratory is also open from October to end of April two evenings per week for practical work.

Lectures one evening each week.

A separate working bench is provided for each Student, and he is also supplied with all ordinary chemicals, gas, fuel, and the more substantial portions of Laboratory apparatus, but must provide himself with test-tubes, beakers, and other apparatus of a fragile nature.

In addition to the ordinary chemical studies, the course of instruction will, as far as possible, comprise all such studies as may be required for the successful prosecution of the particular branch or branches of Applied Chemistry in which the pupil is to engage; as, for example, in the case of one intended for manufacturing pursuits, he would study architectural and mechanical drawing, so far as is required for the preparation of plans, &c., of chemical apparatus and manufactories, the nature and use of building materials, and the scientific principles and practical rules involved in building and constructive operations, and other scientific and practical information required in the arrangement, construction, and management of chemical manufactories, and the application of Chemistry to industrial pursuits.

COLLEGE OF CHEMISTRY, LIVERPOOL.

Founder.—Dr. Muspratt, M.D., &c.
Principal.—Mr. Martin Murphy, F.C.S., Professor of Chemistry.

The Course of Instruction given in the College of Chemistry comprises the teaching of Chemistry as a science, and the general application of chemical knowledge; also the teaching of the principles of those branches of physics which are allied with chemistry, such as light, heat, electricity, &c.

Particular attention is devoted to instruction in the practice of systematic analytical operations, whereby students will be enabled to determine accurately the general and proximate constituents of substances, and so arrive at a knowledge of their nature and properties.

Instruction in the application of chemical data to medicine and agriculture, and to the chemical and metallurgical operations, comprising Technology, will be given, to qualify students for these avocations.

The students will invariably be controlled and directed in their study and work by the Principal and competent assistants. Ample laboratory accommodation is provided for students, and such general appliances as will facilitate their progress in acquiring a knowledge of the specialities taught in the college.

The student's laboratories are open throughout the year. Hours of attendance—From 10 a.m. to 5 p.m. daily.

Fees—10 guineas per quarter of 3 months, or 35 guineas per annum, payable in advance. Students provide al their own apparatus and books.

Medical and Pharmaceutical students are admitted for 1 hour per day. Fee for 3 months, £2 2s.

A Course of Lectures will be delivered to the students during the winter months. Evening Classes.

Certificates of attendance recognised by the University and Apothecaries' Hall of London, and Apothecaries' Hall of Ireland.

LEEDS SCHOOL OF MEDICINE.

WINTER SESSION.

Lecturer.—Mr. J. Chapman Wilson, F.C.S.

Daily, except Wednesday and Saturday, at 11 a.m. First session, £4 4s. Second Session, £3 3s.

SUMMER SESSION.

Practical Chemistry.—Mr. Wilson, F.C.S.

Mondays and Tuesdays, 9.30 to 11. Each course, £3 3s.

General Chemical Students.—The Laboratories are open daily, under the direction of Mr. Wilson, for the instruction of General Students in Chemical Manipulation, Technical Chemistry, and all branches of analysis; and also for the use of gentlemen wishing to pursue special chemical researches.

The fees, payable in advance to the Treasurer, are as follows:—For one month, £4 4s.; for two months, £7 7s.; for three months, £10 10s.; for four months, £13 13s.; for five months, £15 15s.; for six months, £17 17s.; for nine months, £21. Special fees will be charged to Students who do not wish to work every day in the week.

The Chemical Museum contains minerals, metallic ores and metals, rare chemical substances, and illustrations of the most important chemical manufactures in their different stages.

Curator.—Mr. Scattergood.

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LEEDS MECHANICS' INSTITUTION AND LITERARY SOCIETY'S LABORATORY.

Chemical Classes and Laboratory for Instruction in Elementary, Practical, and Analytical Chemistry.

Lecturer.—Mr. George Ward, F.C.S., with Assistants.

HIGH HARROGATE COLLEGE, YORKSHIRE.

Professor of Chemistry.—Mr. W. G. Mason, F.C.S., Certificated Science Teacher.

MANCHESTER GRAMMAR SCHOOL.

CHEMICAL DEPARTMENT.

Professor.—Francis Jones.

Instruction is given in Inorganic Chemistry, Organic Chemistry, Metallurgy, and Analytical Chemistry. There is a lecture-room and second laboratory, affording accommodation for seventy-two Students.

MANCHESTER ROYAL SCHOOL OF MEDICINE.

(INCORPORATED WITH OWEN'S COLLEGE).

Lecturer on Chemistry.—Mr. Daniel Stone.

The usual Course for the Medical Boards.

A Laboratory is connected with the School.

OWEN'S COLLEGE, MANCHESTER.

Chemistry.—Professor H. E. Roscoe, B.A., Ph.D., F.R.S., F.C.S.

Senior Assistant.—Mr. C. Schorlemmer, F.R.S.

Junior Assistant.—Mr. Henry A. Smith, F.C.S.

Junior Class.—Wednesday and Saturday, from 9.15 to 10.15 a.m.

Subject: Inorganic Chemistry, comprising the laws of chemical combination, and a description of the properties and mode of preparation of the non-metallic elementary bodies and their most important compounds.

Senior Class.—Tuesday and Thursday, from 9.15 to 10.15 a.m.

Subjects: Inorganic and Organic Chemistry, including the properties of the metals and their compounds, and the composition and relations of the best defined groups of organic bodies, and the laws regulating their formation.

Students are expected to answer the written exercises and attend the *viva voce* examinations given in these Classes.

Fee—For each Class, £3 3s.; for both Classes, £5 5s.

A Recapitulatory Lecture, without additional Fee, will be given on Friday at 9.15 a.m., which members of both Classes will be required to attend.

Organic Chemistry (Extended Course).—Wednesday, from 3 to 4 p.m., and Friday, from 4 to 5 p.m.

This Course, on the Chemistry of the Carbon Compounds, in which the subject of Organic Chemistry will be completely treated, will be given by Mr. C. Schorlemmer, F.R.S.

Fee, £3 3s.

Extra Class.—Wednesday, from 4 to 5 p.m.

Subject: Technological Chemistry.

The Chemical Principles involved in the most important Chemical Manufactures will be chiefly considered in this Course.

Students attending this Class must be acquainted with the principles of Chemical Science. Fee, £2 2s.

Analytical and Practical Chemistry.

LABORATORY COURSE.

Professor.—Henry E. Roscoe, B.A., Ph.D., F.R.S.

Senior Assistant.—Mr. C. Schorlemmer, F.R.S.

The aim of this Course is to make the Student practically acquainted with Chemical Science, to enable him to conduct analysis and original research, and to fit him for applying the Science to the higher branches of Art, Manufactures, and Agriculture. To accomplish this, an attendance of not less than four days per week during three whole sessions is as a rule necessary. It is very advisable that each Laboratory Student should attend or should have attended the Course of Lectures on Theoretica Chemistry,

The College Laboratory will be open for Students daily from 10.30 a.m. until 5 p.m., except Saturdays, when it will be closed at 1.30. The Laboratory is closed from 1.15 until 2, for dinner.

The Laboratory is fitted with every convenience for the prosecution of practical chemistry, all branches of qualitative and quantitative analysis, and original research.

Each Student is provided with a separate working table, set of tests, fuel, water, and gas, free of expense; but he is required to find his own apparatus, a few of the more expensive reagents, and the chemicals required for his experiments. Other apparatus or instruments of a more expensive description may be obtained on loan from the Laboratory Steward, subject to regulations to be prescribed by the Professor.

Fees for the Session.—Students working six days per week, £21; ditto, four days, £17 17s.; ditto, three days, £13 13s.; ditto, two days, £9 9s.; ditto, one day, £5 5s. Students entering the Laboratory Class at or after Christmas, for not less than two days per week, will be charged two-thirds of the fees for the whole session.

Special Fees for Shorter Periods.—For six months, six days per week, £17 17s.; five months, ditto, £15 15s.; four months, ditto, £13 13s.; three months, ditto, £10 10s.; two months, ditto, £7 7s.; one month, ditto, £4 4s.

Lectures on the methods of Qualitative and Quantitative Analysis, intended to supplement the instruction in Practical Chemistry, will be given by Mr. C. Schorlemmer, F.R.S., on Mondays, from 4 to 5 p.m.

First year's Laboratory Students are recommended to attend and answer the written exercises and the *viva voce* questions given in this Class. Fee, £1 11s. 6d.

Chemical Calculations.—In this Class, instruction and special practice is given by Mr. C. Schorlemmer, F.R.S., on Wednesday, from 4 to 5 p.m., in the methods of Chemical Calculations, serving as supplementary to the Lecture and Laboratory Courses. Fee, £1 1s.

The Lectures on Chemistry in Owen's College are recognised by the University of London for its Medical Degrees, by the Royal College of Surgeons, and by the Apothecaries' Hall.

EVENING CLASSES.

Chemistry.

First Lecture Course.—(The Non-Metallic Elements).—Professor Roscoe. Monday, from 8.30 to 9.35 p.m.

Second Lecture Course.—(The Metals).—Mr. Smith. Friday, from 8.35 to 9.35 p.m.

Third Lecture Course.—(Organic Chemistry).—Mr. Schorlemmer. Thursday, from 8.35 to 9.35 p.m.

Laboratory Courses.—Professor Roscoe, Mr. Schorlemmer, and Mr. Smith. Monday, from 6 to 8.30 p.m.

COLLEGE OF PHYSICAL SCIENCE, NEWCASTLE.

(IN CONNECTION WITH THE UNIVERSITY OF DURHAM).

Professor of Chemistry.—A. Freire-Marreco, M.A.

Junior Division—General Principles of Chemistry; History of the non-metallic Elements.

History of the Metals and their more important compounds; Principles of Qualitative Analysis, Monday, Wednesday, and Friday at 11 a.m.

Senior Division—Elements of Organic Chemistry, Tuesdays, at 11 a.m. Applied Chemistry, Thursdays, at 11 a.m. Fee £5 5s.

Practical Chemistry.—The Laboratory is open from 10 a.m. to 1 p.m., and from 2 to 5 p.m., except on Saturday, when it closes at 1 p.m.

Laboratory Fees.—Students working six days per week, five guineas per term. Students working alternate days, three guineas per term. Students working one day per week, one guinea per term.

Evening Classes—Inorganic Chemistry, Mondays, at 8, commencing November 4, 1872.

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SHEFFIELD SCHOOL OF CHEMISTRY.
1 and 3, SURREY STREET, SHEFFIELD.

Mr. A. H. Allen, F.C.S., delivers a Course of Thirty Lectures on Inorganic Chemistry and Metallurgy. Day and Evening Classes for the practice of Analytical Chemistry and Assaying.

SHEFFIELD SCHOOL OF MEDICINE.

A Course of Forty-Five Lectures on Inorganic and Organic Chemistry will be delivered during the Winter Session, by A. H. Allen, F.C.S.

The Summer Course of Practical Chemistry is conducted by Mr. Allen.

SCOTLAND.

UNIVERSITY OF EDINBURGH.

Professor of Chemistry.—Dr. A. Crum Brown, F.R.S.

ROYAL COLLEGE OF PHYSICIANS AND SURGEONS, EDINBURGH.

Lecturer on Chemistry.—Dr. Stevenson Macadam, F.R.S.E.

The Courses of Instruction in Chemistry include its applications to Medicine, Agriculture, and the Industrial Arts; and they qualify for the University of Edinburgh and other Universities, the Royal Colleges of Physicians and Surgeons, the Navy, Army, and Indian Medical Service, and the other Medical and Public Boards.

The Lectures on Chemistry are delivered daily during the five months of the Winter Session. The Lectures form a complete Course, and special Lectures on Technological Chemistry are given. Tutorial Class Examinations are held during the Session.

The Instructions in Analytical Chemistry are conducted in the Laboratories at Surgeons' Hall, which are now open daily, under the personal superintendence of Dr. Macadam, for the instruction of gentlemen in Chemical Analysis, and the prosecution of researches in Manipulative Chemistry.

The Prelections in Practical Chemistry are also conducted in the Laboratories at Surgeons' Hall. The subjects selected for Examination are those with which Medical Students are specially called upon to exhibit a practical acquaintance.

Fees.—Lecture, £3 5s. (University Graduation, £4 4s.) Practical Chemistry (University, &c.), £3 3s.; Analytical Chemistry, £2 per month, £5 for three months, or £10 for six months.

UNIVERSITY OF GLASGOW.

Professor of Chemistry and Practical Chemistry.—Dr. Thomas Anderson, F.R.S.E.

ANDERSONIAN UNIVERSITY, GLASGOW.

Professor of Scientific Chemistry.—Dr. T. E. Thorpe.

GLASGOW MECHANICS' INSTITUTION.

Professor of Chemistry and Practical Chemistry.—Dr. R. Carter Moffat.

GLASGOW VETERINARY COLLEGE.

Professor of Chemistry.—Dr. R. Carter Moffat.

SCHOOL OF CHEMISTRY,
42, BATH STREET, GLASGOW.

Dr. Wallace, Mr. Tatlock, and Dr. Clark.

Scientific course of Lectures on Inorganic and Organic Chemistry, by Dr. Clark. From 12 till 1 daily. Commencing Tuesday, November 5. Fee for the course, £2 2s.

Laboratory Instruction in Analytical and Practical Chemistry, from 10 till 4 daily, Saturdays excepted. Commencing Tuesday, November 5. Fee for Six months, exclusive of apparatus, £8 8s.

Private Pupils, number limited to Three, £26 5s., for six months.

Evening course of Laboratory Instruction in Analytical and Practical Chemistry. Tuesday and Thursday, from 7 p.m. till 9.30 p.m. Commencing November 5. Fee for one night per week, £1 1s. per quarter. Two nights per week, £2 2s. per quarter.

Evening course of Lectures on Chemistry, in connection with the Practical Class, by Mr. Tatlock. Every Friday, from 8 p.m. till 9 p.m. Commencing November 8. Fee for the six months' course, 5s.

Spring course of Practical Medical Chemistry, by Dr. Clark. Commencing Tuesday, January 8. Fee, £2 2s.

Summer course of Practical Medical Chemistry, by Dr. Clark. Commencing Tuesday, May 5. Fee, £2 2s.

IRELAND.

DUBLIN.—TRINITY COLLEGE.

Professor of Chemistry.—Dr. Apjohn, F.R.S.

ROYAL COLLEGE OF SURGEONS, DUBLIN.

Professor of Chemistry.—Dr. Barker.

QUEEN'S COLLEGE, BELFAST.

Professor of Chemistry.—Dr. Andrews, F.R.S., &c.

QUEEN'S COLLEGE, GALWAY.

Professor of Chemistry.——Dr. T. H. Rowney.

A Laboratory for Practical Instruction is attached to all the Queen's Colleges. The usual Practical Course for the Medical Boards is given in the summer.

ROYAL COLLEGE OF SCIENCE FOR IRELAND.
STEPHEN'S GREEN, DUBLIN.

This college supplies as far as practicable, a complete course of Instruction in Science, applicable to the Industrial Arts. The subjects of Instruction are:—Pure and Applied Mathematics, Descriptive Geometry, and Mechanical Drawing, Mechanism, Theoretical and Applied Chemistry, Chemical Analysis, Physics, Botany, Zoology, Geology, and Palæontology, Mineralogy, Mining, Machinery, Surveying, and Agriculture.

Professor of Theoretical Chemistry.—W. K. Sullivan, Ph.D., V.P.R.I.

Professor of Analytical and Applied Chemistry.—R. Galloway, F.C.S.

Assistant Chemist.—W. Plunkett, F.C.S.

A course of Lectures on Inorganic and Organic Chemistry is delivered by Dr. Sullivan three times a week during the Session. Fee for the entire course, £2.

A course of Lectures on Technological Chemistry is delivered by Mr. Galloway twice a week during the session. Fee for the course, £2.

The chemical and Metallurgical Laboratories, under the direction of Mr. Galloway, are open every week day during the session, except Saturday. Instruction is given in the different branches of Analytical Chemistry, including Assaying, and in the methods for performing Chemical research. Each student is taught, not in class, but separately and independently; and he is supplied with a separate working table, with reagents, fuel, water, gas, and the larger and more expensive apparatus. Fee, for the session of nine months, £12; or for three months, £5; or for one month, £2.

There are four Royal Scholarships, of the value of £50 each yearly, with free Education, including Laboratory Instruction, tenable for two years; two become vacant each year; they are given to students who have been a year in the College. There are also nine Exhibitions attached to the College, of the yearly value of £50 each, with free Education, including Laboratory Instruction, tenable for three years; three become vacant each year. These are awarded at the annual May Examinations of the Science and Art Department.

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A Diploma of Associate of the College is granted at the end of the three years' Course.

The Session commences on Monday, October 7th.

ON NOCTILUCINE.

By Dr. T. L. PHIPSON, F.C.S.

I HAVE given the name of noctilucine to a peculiar organic substance, first alluded to in my paper in the *Comptes Rendus* for 1860 (2e semèstre, p. 541), and again in my work on "Phosphorescence" (London, 1862, p. 103), as the substance which causes the production of light in phosphorescent fish. This remarkable compound, which might almost be termed the *organic phosphorus*, is also the cause of the production of light by the glowworm, and probably by all other phosphorescent animals; it appears to be formed in a variety of circumstances at the expense of dead animal and vegetable tissue, and even by certain living plants (*Euphorbia*, *Agaricus*, &c.). My observations at present relate only to noctilucine as produced in the animal world.

At the ordinary summer temperature noctilucine is a semi-fluid, almost liquid, substance containing nitrogen; it is white, and in its natural state contains a considerable amount of water; it has a slight odour, resembling that of caprylic acid; it is only slightly soluble in water, and is somewhat lighter than this liquid; it is insoluble in alcohol and ether, and is decomposed by acids and alkalies. Nitric acid easily dissolves and decomposes it; sulphuric acid, also, and potash evolves ammonia from it. In fermenting, in contact with water, it produces an odour of putrid cheese; as long as it is moist, it absorbs oxygen and evolves carbonic acid in the air. When left to itself it dries up, in the course of a few hours, to thin, shining, translucent films, quite devoid of structure, and resembling the *mucine* of the common garden snail.

When recently produced noctilucine is highly phosphorescent, and this production of light is owing to oxidation in contact with the air. It also shines for a little time in water, as long as there is air in the water; it is rather more brilliant in oxygen gas, and still more brilliant in a south-west wind, which I find usually contains much ozone. This production of light ceases as soon as the oxidation is completely accomplished; but as long as the smallest amount of air adheres to it, it will shine, even in carbonic acid, for a short time.

Noctilucine is secreted in phosphorescent animals by a special organ, just as bile is secreted by the liver, and appears to be used in producing light nearly as fast as it is formed. It is also produced in certain conditions of temperature and moisture, in dead animal matter of various descriptions (pork-flesh, beef, blood, fish, &c.) and occasionally in urine. Whatsoever its source, it shows the same kind of light, nearly monochromatic; the same spectrum, principally developed between the lines E and F; and, as far as I have examined them, the same chemical properties.

In an impure state, noctilucine can be obtained from the surface of various fish when highly phosphorescent, also from the glowworm, by pressing the luminous matter collected by the scalpel through porous filtering-paper. It is secreted in a pure form by the luminous centipede (*Scolopendra electrica*), and on the 15th of September, 1871, I procured some from this source. When a number of these *Scolopendræ* are caused to run about a large glass capsule, they leave a certain amount of noctilucine upon the surface of it, sufficient to enable one to examine the principal properties of this curious substance.

The secretion of noctilucine in the higher phosphorescent animals, such as the glowworm and the firefly, is to a certain extent dependent upon the nervous system of these insects; hence they have the faculty, apparently, of shutting off their light at will. In this case the secretion is stopped for the time; but a certain quantity of noctilucine exists in the eggs of the glowworm, which also shine for some time after they are deposited.

There appears to be a special organ for the secretion of noctilucine, even in the minute *Noctiluca miliaris* of the English Channel, and other lower types of phosphorescent animals; and even here, where we find scarcely any rudiments of a nervous system, the secretion of the luminous substance appears to depend greatly upon external circumstances.

DIDYMIUM IN BRITISH MINERALS.

By A. H. CHURCH, M.A., F.C.S.

DIDYMIUM was first discovered in a British mineral by Mr. C. Greville Williams, F.R.S., in the year 1865. This fact is recorded in the CHEMICAL NEWS, vol. xii., p. 183. The mineral containing this rare metal was described by me as "a new British mineral containing cerium." Analyses proved it to be a hydrated phosphate of the cerium metals, the latter, calculated as cerous oxide, constituting no less than 51·9 per cent of the mineral. Specimens of this mineral may be seen in the British Museum, Mineral Case No. 57. It is, however, very rare, and I hesitated to sacrifice the specimens which I possess in order to attempt a precise estimation of each of the cerium metals present. It occurred in a Cornish copper lode on quartz and killas. A concise description of the species will be found in Dana's "Mineralogy," p. 555, (5th Edition, 1868).

The above remarks were suggested by Mr. C. Horner's note on the presence of didymium in pyromorphite (CHEMICAL NEWS, vol. xxvi., p. 69). The occurrence of cryptolite in certain British, as well as foreign specimens of apatite has been ascertained. Now as crypotolite is an anhydrous phosphate of the cerium metals, it may be considered that the discovery of this species in apatite is equivalent to the detection of didymium in that mineral. I must say I have failed to find even a trace of cryptolite in the true asparagus-stone, the beautiful greenish-yellow crystals of apatite, from Juniella, in Murcia, Spain.

Mr. Horner's discovery of didymium in pyromorphite will naturally lead to the search for the other cerium metals in that mineral.

Isopurpuric Acid and Salts as Dye Materials.—According to the recent researches of Dr. E. Kopp, isopurpurate of potassa is best obtained by treating an intimate mixture of picric acid and cyanide of potassium, first with a small quantity of cold water, and after this mixture has been left standing for about half an hour, more water is added and the temperature raised to from 40° to 45°; after cooling, the mass is purified according to Hlasiwetz's process. The best mordants for isopurpurates on silk and wool are mercuric and lead salts; the hue of the colours produced differs from that of those produced from murexide under the same conditions, inasmuch as the isopurpurates yield a magnificent purple with a somewhat brownish orange hue. The colour is fast as regards sunlight and sulphurous acid, both of which destroy murexide colours. While murexide-zinc yields a beautiful yellow, isopurpurate of zinc yields deep red, somewhat brownish, hues. Murexide colours do not stand acids and alkalies at all; these reagents render isopurpurate colours somewhat yellow. The alkaline isopurpurates are explosive salts, but the purpurates are not; many reagents decompose these salts entirely, giving rise to the formation of secondary compounds. Isopurpurate of potassa is more advantageously prepared by causing the cyanide of potassium to act upon the picrate of ammonia.

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SUPPLEMENT
TO THE
CHEMICAL NEWS.
VOL. XXVI. No. 668.

THE STUDY OF CHEMISTRY.

CHEMISTRY may be studied as a means to an end, and as an end. The importance of chemistry to every kind of manufacture has become fully acknowledged as not only affording many improvements, but as a means of economy. But to the chemical manufacturer, as well as to the purely scientific chemist, the advanced study of chemistry is the end of their labours; yet in both instances the routine pursued by the students may be the same, the difference being one of degree of attainment. We say that the routine may be the same, for we cannot recognise the method of committing to memory some text-book as being at all worthy of the name of a course of scientific study. Such a method is perhaps suited to the debating society, where the casual employment of a hard name bears an indefinite effect, but is certainly not calculated to supply knowledge that either would satisfy a conscientious examiner or be of material worth. There is, then, left two methods of study, differing, as has been said, only in degree—(1) study by attendance in class on experimental lectures, with *viva voce* instruction; (2) study, either singly or collectively, in a laboratory under a practical chemist. These methods bear to each other a relation somewhat similar to that existing between clinical medicine as studied in the hospital and in practice, or between book-keeping learnt at school and pursued in the office. The first method may precede the second with advantage, but alone it will rarely lead to thorough comprehension of the science, because the student is so much dependent upon the reasoning of his Professor, that for practical work by himself he remains quite unprepared, unless the second method should have been to some, and even slight, extent supplementary. There are, too, so many points of detail that fix themselves indelibly in the memory during a course of laboratory work, to which hand and mind become alike accustomed, and which even the lapse of years will not obliterate. This view of chemical science, its consideration as a collection of experimentally-ascertained facts, is most essential to the student. A presently-received theory may in the course of years undergo such marked changes as to appear almost unrecognisable to those to whom the changes have passed unnoticed; but a fact—well, "a fact is a fact for ever"—and, once made, by experiment, the student's own, is equally ever afterwards an inalienable property. It has unfortunately been a course too often adopted to ask, of students qualifying for science certificates, a merely theoretical knowledge of their subject. But several instances could be indicated where there is a growing tendency to test the knowledge of the candidate experimentally and practically. And that this tendency meets with encouragement, from the students themselves as well as from examiners, is evidenced by the transference of the principal source of our chemical instruction from the School of Mines and Oxford Street to larger lecture-rooms at South Kensington, as well as by the foundation of institutions such as the College of Physical Science recently established at Birmingham. The student of to-day enjoys the further advantage of a course of chemical instruction—elementary it may be—during his school days, especially if he be intended to attempt an Oxford or Cambridge Local Examination, elementary examinations that are eminently practical in their nature. That the importance of early culture in scientific enquiry is becoming duly recognised is also evident from the impetus given to science studies at the somewhat exclusive Universities of Oxford and Cambridge. From the former seat of learning we have been accustomed to hear from the lips of the Waynflete Professor brilliant elucidations of the most intricate reasoning on chemical subjects, and it is not without pleasure that we note the acceptance of the chair by Dr. Odling, F.R.S., whose practical teaching at the Royal Institution has met with so much favour. At Cambridge, the election of a Science Tripos is an act of to-day. At the Universities of London, Dublin, Edinburgh, Glasgow, and others, the science classes were never so well attended and the candidates for scientific distinction so numerous. And it is interesting to notice that the attention bestowed upon chemistry is far above that given to any one other subject of scientific study, arising doubtless from the manner in which chemistry, owing to the numerous discoveries of the last decade, is fast becoming an integral part of other applied science. A knowledge of chemistry is now almost as essential to the engineer as to the chemist. In naval architecture, recent events have proved that the disregard of molecular action may be attended with awkward consequences; while the highest branches of chemical enquiry are brought in to aid in the improvement of the material itself of which our vessels are constructed. To enumerate the results of the application of chemistry to manufacture during the last century would be to record more brilliant triumphs than are to be found in the annals of Ancient Greece and Rome. Who would not endeavour to follow, however distantly, in the footsteps of such men as Faraday, Wollaston, and others of the day whose names are household words?

Turning from the higher branches, we have the classes for instruction in science under the direction of the Committee of Council of Education, in which the artisan may gain an acquaintance with the rudiments of chemistry. The teaching of these classes has always been practical, and its benefit, although felt but only indirectly, is none the more real; and that it is fully appreciated is shown by the eagerness with which the testimonials of the Department are sought.

Medical and toxicological chemistry, a branch spreading widely from the parent tree, is, from the increased delicacy of means of determination, now able to prepare or detect the most subtle medicines and poisons with an accuracy formerly unthought of. Chemistry, in short, must now rank as one of the exact sciences, as it is one of the most important; and without doubt it has arrived at its present stage of advancement by means of a careful discrimination and a close attention to *fact*.

In placing before our Students this number of the CHEMICAL NEWS, specially devoted to them, and in recommending to their notice the curricula of the several schools, we admonish them to a practical, or rather, should we say, experimental, course of study in the science they have chosen.

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THE SEWAGE COMMITTEE OF THE BRITISH ASSOCIATION.

PRACTICALLY the Gun-Cotton Committee of the British Association was Professor Abel, and now practically the Sewage Committee is Mr. Hope. That Mr. Hope's sewage-farm at Romford is skilfully and advantageously worked, and more especially shows the merits of sewage irrigation, strikingly set forth and contrasted with other ways of disposing of sewage, may be, and we believe is, essentially true—but why this should be, as it appears to be, the sole accepted mission of the Committee of the British Association on the Treatment and Utilisation of Sewage, is not so clear.

It will possibly be within the knowledge of some of our readers that in the year 1870 this Committee collected £1530 from various towns in the United Kingdom, and so became possessed of a sum of money equal to the collective amount which the British Association spends annually upon all its committees.

At the recent meeting of the Association in Brighton, the Sewage Committee announced that it had expended all its money and applied to be re-appointed, and for a grant of £100 from the general fund of the Association. Furthermore, there was an intimation that a repetition is contemplated of its appeal to the towns for pecuniary assistance.

Under these circumstances, the history and doings of this Committee are of public interest; and, indeed, one of the leading London papers has publicly remonstrated with the leader of Her Majesty's Opposition in the House of Commons, for not taking part in "the great sewage debate" in Section B.

Here we may observe, in passing, that curiously enough the very occurrence of this great sewage debate appears to be contrary to the rules, or at any rate to the ordinary course of procedure, in the Sections, of the British Association, and that we are indebted for it to the public spirit and sense of right of the President, Dr. Gladstone, who, resisting official pressure, put the question to the Chemical Section on the Tuesday, whether or not there should be a sewage debate on the Wednesday. The question was answered unanimously in the affirmative by the members of the Section, and accordingly the debate came off.

The Sewage Committee of the British Association began very humbly at the Norwich meeting in the year 1868 with a grant of £10. In the following year it was re-appointed in Exeter, and received a grant of £50; and between that meeting and the meeting in the summer of 1870, as already described, it executed the feat of collecting £1530 from the towns.

The Committee appointed in Exeter, in 1869, consisted of Mr. Grantham, Mr. Denton, Mr. Harrison, Mr. Hope, Dr. Paul, and Professor Wanklyn; and was constituted "without power to add to its number." It nevertheless added Professor Williamson and some others, and appealed to the towns for funds. A question then arose with the Committee as to the application of the money. One party maintained that members of the Committee were bound to work for the Committee, and that the payment of personal expenses, while actually thus engaged, was a legitimate application of the funds. The other party maintained that the members were not bound to work, and that the receipt of personal expenses would not be sanctioned by the British Association. The dispute related mainly to the chemical work, and was between the two chemists who had been appointed at the Exeter meeting, and who wished to work, and the other chemist subsequently appended. The dispute grew, and was complicated by the further question whether a committee, without explicitly getting power to add to its members, could exercise such a power? and the Council of the Association was appealed to, and decided that all *Committees of the Association* have power to add to their number, whether they are constituted "with power" or not.

In this way Professor Williamson, the chemist appended by the Committee, triumphed over Dr. Paul and Professor Wanklyn, the chemists appointed by the Exeter meeting of the Association. At Dr. Williamson's suggestion, and in opposition to the protest of Messrs. Paul and Wanklyn, a former assistant of his, viz., Dr. Russell, at that time of St. Mary's Hospital, and at present of St. Bartholomew's, was nominated chemist to the Committee.

Messrs. Paul and Wanklyn thereupon issued a circular to the subscribing towns respecting this transaction, stating that the question put to the subscribing towns was whether the main work of the Committee was to be done by its members at an unremunerative rate, or by friends of the Committeemen at a remunerative rate. Many towns returned answers favourable to Messrs. Paul and Wanklyn, but not having sufficient support within the Committee, they protested, and left the field to Dr. Williamson, who, in conjunction with his nominee, Dr. Russell, is responsible for the chemical work of the Committee.

Of the six members of the Sewage Committee appointed in 1869 by the British Association in Exeter, only Mr. Grantham, who was chairman, and Mr. Hope, who is proprietor of a sewage-farm on which the Committee make experiments, remain in a state of activity. Of the other four members three have withdrawn, and one, viz., Mr. Harrison, has become passive. Tracing the history of the Committee, we find that it reported and was re-appointed in Liverpool in 1870; that it reported and was re-appointed in Edinburgh in 1871; and again in Brighton in 1872. Confining ourselves to the events in Brighton, we have to record that attention was called to the circumstance of this Committee applying to the sectional Committee of the Mechanical Section of the British Association for recommendation to be re-elected, before its report had been read, in the Section; that after the reading of the report discussion was forbidden, as being contrary to the rule of the Association; and that efforts were made to prevent the discussion of it in the Chemical Section, but that they were frustrated by the determination of the President and the action of the Section. When the debate came off, considerable distrust of the accuracy of the work done was expressed in some quarters. The report itself was strongly in favour of irrigation.—*Mechanic's Magazine.*

CHLOROPHYLL AND ITS RELATION TO LIGHT.*

By Professor LOMMEL.

IT is well known that green plants decompose the carbonic acid in the atmosphere, retaining the carbon and giving back the oxygen. This assimilation of carbon takes place in the chlorophyll cells under the influence of light. The chlorophyll will not effect it without light of fitting quality and intensity; the light will not effect it where there is no chlorophyll. Hence it is important to study the relation of chlorophyll to light.

Two optical properties of chlorophyll may here be considered: its *absorption* of light, and its *fluorescence.*

To study the former, an alcohol or ether solution of chlorophyll is placed between the source of light and the slit of a spectroscope. The position of the absorption-bands may be compared with that of Fraünhofer's lines.

Where there is much thickness of liquid, or the solution is a strongly-concentrated one, the extreme red only appears; the rest is absorbed. On further dilution, green, yellow, and orange successively appear. A solution from fresh leaves gives a spectrum with the following characteristics:—Immediately after B, in the middle of the red, is a dark band extending a little beyond C; this

* Abstract of a Paper in *Poggendorff's Annalen*

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may be numbered I. Another weaker absorption-band appears in the orange-yellow, half way between C and D (II.), a third (III.) in the greenish yellow after D, a fourth (IV.) in the green immediately before E. The order now given is also that of their intensity. The rest of the spectrum from before F is absorbed. Only, in certain cases, a slight weakening of the absorption appears about G, which may thus be regarded as the dividing line between two very broad absorption-bands, numbered by Hagenbach VI. and VII. Hagenbach's line No. V. is one which only appears from a solution that has been standing some time; it is situated between B and F.

Next, as to fluorescence. When a solution of green leaves is placed in sunlight or candlelight, *e.g.*, it shines with a peculiar dark red light, which may be intensified if the incident light is concentrated by a lens, and then the liquid appears as if self-luminous. To ascertain which part of the incident light caused this appearance, a solar spectrum was cast on the surface of the solution. The red gleam appeared throughout the extent of the spectrum from a little before B to the ultra violet part, and with varying intensity. Seven bright bands were discernible, and each of these corresponded, in position and intensity, to a dark band of the seven perceived in the former absorption spectrum. (Or, if No. V. be discarded, which only appeared in the modified solution, then VI. and VII. became one.)

The fluorescent spectrum was then, by means of a cylindrical lens, contracted to a narrow band, and this was examined through a prism with the refracting surface parallel to the spectral band. The spectrum of this "diverted" fluorescent light contained only red rays, with a refrangibility corresponding to that of the rays between B and C in the solar spectrum.

We thus learn that only the rays of light which are liable to absorption produce fluorescence in the solution, and the fluorescence is proportional to this liability. Further, the fluorescence may be called forth by any homogeneous ray.

The connection between fluorescence and absorption may be here looked at a little more closely.

Euler established the principle that a substance absorbs all those rays of light with whose rate of vibrations the vibrations of its smallest particle can agree.

Each molecule of a substance, according to its chemical structure, has certain determinate rates of vibration. If it is struck by a wave whose period agrees with one of those proper to itself, it is set in motion, or has its motion strengthened, if it has already been vibrating. The wave gives up its energy, partly or wholly, to the molecule, goes through the substance weakened, or does not go through at all, *i.e.*, it is absorbed.

Other vibrations, not agreeing with those of which the molecule is capable, pass through. We have an analogous case in Resonance. It must further be pointed out, however, that wave motion may also be absorbed when the molecule's rate of vibration is only half as great, or twice as great, as that in the wave; or, to use acoustical language, when it is an *octave* lower, or an *octave* higher, than the impinging wave. This may be called the principle of *indirect*, and the former that of *direct*, absorption. Such indirect absorption, as may be supposed, commonly exceeds the direct in energy, and absorption through the lower octave is generally greater than that through the higher.

Once more, a molecule is commonly capable, not of one kind of vibration only, but of various, which are more or less readily excited; and in whatever way the molecule is put into vibration, all those vibrations will take place simultaneously which are proper to it. In acoustics, there is the analogous case of *obertöne*, or overtones.

We have, then, the principle, that when a molecule, through direct or indirect absorption, is put in vibratory motion, it vibrates not only in the vibration-period of the absorbed wave, but the other vibrations proper to the molecule are conjoined with this.

Thus we may see how the chlorophyll molecule acts. We perceive that it is capable of vibrating in the vibration-period of the rays between B and C and the next octave below, while it vibrates only in the next lower octave of the more refrangible rays. In the former case there is direct and indirect absorption, in the latter only indirect. In those parts of the spectrum with whose vibration-period, or the next lower octave, the chlorophyll molecule readily agrees, there are dark absorption-bands. The dark bands in blue and violet arise from the molecule vibrating with half the vibration-period of the blue and violet rays; while, in the case of the bands between B and C, the molecule vibrates not only with half the vibration-period of the red rays, but also with the same vibration-period.

The molecule, set in vibration, itself sends out rays, one portion of which have rates of vibration half as great as those of the rays from B to the violet end of the spectrum, and another, rates equal to those of the rays between B and C. The former are not perceived, being in the ultra-red; the latter are perceived as red fluorescent light.

Hence may be understood how every absorbed ray, whatever its colour, produces only red fluorescent light; how the bright fluorescence bands correspond to the dark absorption-bands; and how the extreme red before B, which is not absorbed, also excites no fluorescence.

This theory is in opposition to that of Stokes, according to which every ray giving rise to fluorescence calls forth only such rays as have a rate of vibration inferior to its own. By the use of an alcohol solution of rose of Magdala, I have also been able to obtain yellow and greenish yellow rays from red rays. (An additional experiment confirmatory of the theory is here described.)

Chlorophyll in the leaf acts much in the same way, with reference to light, as chlorophyll in solution. It was found, however, that, on causing the light to pass through a single leaf, the absorption-bands II., III., and IV. (which appeared in the solution) were not present. There was strong absorption only in the red between B and C, and in the violet; chlorophyll in the solid state, moreover, gives no fluorescence.

If, now, we seek to answer the question, What kind of rays are most productive of the assimilation of carbon in the plant? it is clear, first of all, that only an absorbed ray can act chemically. The chemical action in the cell arises from the energy communicated on absorption of the ray. The most chemically-efficient ray must therefore be sought among those that are most easily and perfectly absorbed.

But it is also necessary to know the "mechanical intensity" of the ray. A ray that is not absorbed will not produce chemical action; and a ray which is perfectly absorbed produces but a small effect if its mechanical intensity is small.

Have we the means of measuring the mechanical intensity of sun-rays?

The luminosity of the ray, or its "physiological intensity," furnishes evidently no criterion; nor does the action of rays on salts of silver or explosive gas supply a proper criterion. Every ray may act chemically which is absorbed. Different substances absorb different rays; in one the red, in another the violet, produces chemical action. That the violet and ultra-violet rays act chemically, *e.g.*, on salts of silver, is no reason for distinguishing these as "chemical rays." The curve of so-called chemical intensity in the spectrum only indicates the relation of the rays to particular reagents.

We have, however, in lamp-black a substance with the aid of which the mechanical intensity of all rays may be estimated, since all kinds of rays are perfectly absorbed by it and their energy transformed into heat. By passing a thermopile, the end of which has been covered with lamp-black, along the solar spectrum, the mechanical intensity of the various rays can be measured. By this means it is ascertained that, in a spectrum formed through a rock-

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salt prism, the heating power is at its maximum in the ultra-red: from there it decreases towards the violet end, where it is smallest.

For the assimilating action in plants, the most efficient rays are those which are most strongly absorbed by the chlorophyll, and at the same time have a high mechanical intensity or heating power. They are the red rays between B and C.

The blue and violet rays, though largely absorbed, are little operative, their mechanical intensity being small. The extreme red rays produce no chemical action, because they are not absorbed. The yellow rays, notwithstanding considerable mechanical intensity, are little operative, because they are very little absorbed. The same holds good for the orange and the green.

The experiments I have hitherto made on the assimilation power of plants in light of different colours have confirmed the foregoing statements, or at least have presented nothing in contradiction of them. These experiments can only with difficulty be compared with each other, as the mechanical intensity of the incident rays was left out of account. The thermo-multiplier must in future be regarded as a necessary instrument in any laboratory for the study of plant physiology.

Dr. Lommel concludes with a short account of some experiments by Professor Sachs, of Würtemburg, in which eaves were put in a glass tube containing a known amount of carbonic acid; this was enclosed in a glass receiver, which held a coloured solution, and thus exposed to sunlight. The decomposition of the carbonic acid was afterwards measured. In this way it was found that, with a chromate of potassium solution, which absorbs the more refrangible part of the spectrum and allows the rest to pass, including the efficient red rays between B and C, a marked decomposition took place; with a solution of ammoniac copper, on the other hand, which allows only the blue and violet to pass, and absorbs the remaining part of the spectrum, the action was very little. A chlorophyll solution, for the same reason, gave very little action, the red rays between B and C being absorbed.

ON SOME NEW METHODS OF ANALYSING ETHERS.*

By J. ALFRED WANKLYN.

Two methods were proposed. The first consisted in saponifying the ether, and then measuring or weighing the alcohol formed during that operation. It is well known that the acid obtained on saponifying an ether may be titrated, and Professor Wanklyn showed some years ago that this determination may be made with a high degree of accuracy. The determination of the alcohol set free is, as will be observed, complementary to the determination of the acid.

In carrying out the new process, the following is the method of operation:—

A portion of the ether to be analysed is accurately weighed. 5 or 10 grms. may be conveniently taken. This is then sealed up with excess of aqueous solution of baryta, digested in the water-bath until the decomposition of the ether is complete. The tube is then opened, the contents diluted with water and submitted to distillation—the distillate, consisting of weak alcohol is weighed, and its sp. gr. is taken.

Instead of baryta, it is possible to employ caustic potash in solution in alcohol; but in the latter case it is necessary to use a known quantity of alcohol, which must afterwards be taken into account, being subtracted from the total amount of alcohol which distils over at the termination of the experiment.

The author expects that these estimations of the alcohol evolved on saponification of ethers will prove to be very precise, and that indeed they should be among the most accurate determinations in organic chemistry. That the saponification of an ether can be effected with precision is quite certain. That weak alcohol can be distilled off excess of alkali with precision, the authors experiments on ethylate of soda have proved.

The second process of analysis proposed by Professor Wanklyn is to decompose the ethers by means of excess of strong hydriodic acid. This is especially designed for the fats which are salts of glycerine, and which ought to yield Erlenmeyer's iodide of isopropyl. By this means it is hoped that the percentage of glycerine derivable from any given fat may be estimated. There is a little uncertainty how the acid evolved from a fat will behave towards excess of hydriodic acid, or towards iodine, phosphorus, and water, and this point awaits experiment. The author proposes to examine butter by this process.

* Abstract of a paper read before the British Association, Brighton Meeting, Section B.

NOTICES OF BOOKS.

The Hygiene of Air and Water. Being a popular account of the Effects of the Impurities of Air and Water, their Detection, and the Modes of Remedying them. By William Procter, M.D., F.C.S. London: R. Hardwicke. 1872.

This work gives a clear and simple statement of the injurious effects produced on health by impure air and water. It treats of the various means of detecting the impurities, and gives many useful tests in common language; we quote one of practical value:—"A weak solution is made of permanganate of potash, or Condy's (crimson) fluid, which is a similar solution, is diluted—either of them is the test solution. Take half a pint or more of the water to be examined, previously acidified by the addition of a few drops of hydrochloric acid, or about 12 drops of sulphuric acid (oil of vitriol) diluted with 5 parts of water; add the test solution, drop by drop, whilst stirring, until a faint pink tinge is perceptible. Every 15 minutes the water is to be looked at, and as the colour disappears, a few drops more of the test solution cautiously added, and this is to be continued until the colour remains permanent for half an hour. All the organic matter is then destroyed (oxidised), and the quantity of solution required to effect this gives a rough estimate of the matter originally in the water. The change of colour is better observed by placing the vessel upon a sheet of white paper before a window, and looking down at the paper through the liquid. This is a simple process, and it is within the power of all to ascertain the fitness of our water supply for dietetic purposes." The remainder of the work is equally simple, and as highly valuable in character.

TO CORRESPONDENTS.

*** We cordially thank those gentlemen who so kindly acceded to our request, in sending us the necessary information respecting the Chemical and Medical Schools for our Students' Number.

J. Spiller writes to complain of the adoption, without acknowledgment, in M. Emile Kopp's paper on "Processes for Distinguishing and Separating Silk, Wool, and Vegetable Fibres in Mixed Tissues," published in our issue of the 30th of August, of the specific test for silk which he brought before the Liverpool Meeting of the British Association in 1870.

W. F. White.—Attfield's "Chemistry," published by Van Voorst, or Squire's "Companion to the British Pharmacopœia," published by Churchill.

Luxor.—Hassall's "Adulterations in Food and Drink," or Dafos's Works. See Reviews in vol. xxiii. of Chemical News.

E. Sonstadt.—Thanks for your communication.

C. R. C. Tichborne.—Received.

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OFFICERS OF HEALTH.

THE onerous duties attached to the public position of a Medical Officer of Health render it necessary to consider whether our present system is the best that could be devised. Under the Public Health Act of this year it has been enacted that, for the approval of one of Her Majesty's Principal Secretaries of State, is to be substituted the direction of the Local Government Board in the appointment and removal of analysts. Whether this new *régime* will bring and maintain competent men in the several official positions remains to be seen; but it appears to greatly interfere with the independence of the Officer, who may be exposed to much annoyance and opposition. No one will dispute that the independence of the Officer is a point of the highest importance, and that it should be secured at any cost to the administration. The Officer should be adequately salaried, in order that he may devote his entire energy to the duties of his office; and consequently his appointment should have the permanency necessary to ensure that there may be no fear as to the future.

We have next to consider the qualifications required for the proper discharge of the duties of the office. Not only is it required that the Officer should possess high medical testimonials, he must also be an accurate analyst in the most difficult branches of chemical science. He must be well versed in the detection of poisonous agents and impurities in food, in the water supplied to the community; while, besides his ordinary medical education, the candidate should be expected to have given special attention to the laws of hygiene and of contagious diseases. The question arises, whether one man can be considered to attain to an adequate knowledge of these various branches of science. It is generally held that chemistry alone is the study of a lifetime, while "young" doctors are rarely regarded with a favourable eye. We have, then, ample reason for an innovation, to consist in the separation of the offices of Medical Officer and Analyst. Were these offices distinct, yet worked in partnership, there would even then be sufficient work for each officer. To any one in the least conversant with chemical processes, and the length of time and repetition necessary to an accurate determination, it must appear ridiculous to suppose that the multifarious duties of a Medical Officer of Health can be undertaken by one person with any chance of accuracy in detail. Everyone will therefore be in favour of the movement now set on foot in the parish of St. George's, Hanover Square, where it is proposed to divide the duties of the Medical Officer of Health between two, a medical man and a chemist. The chemist who offers himself is Dr. Dupré, Lecturer on Chemistry at Westminster Hospital; while the medical profession is represented by Dr. R. J. Lee, M.A., M.D. Cantab, Lecturer on Forensic Medicine at the Westminster Hospital. It is to be hoped that these gentlemen will meet with success in their candidature, not only on account of their eminence in their professions, but for the principle which their joint appeal to the parishioners of St. George's involves. The present system, though admirably carried out by some men who have sacrificed themselves to their office, to be placed in some instances under the control of Boards slow to recognise their important services, is daily shown to be susceptible of improvement. The time for improvement has now arrived, and remains in the hands of the vestrymen of St. George's, from which Board, composed chiefly of enlightened men, we may expect, if not acceptance of the proposition now laid before the members, at least reasons for the refusal, or that some modification of the existing system should be suggested.

It will be seen at once that this is far from being a local question; it is one affecting the public generally. The epidemics which have appeared amongst us from time to time having been proved capable of eradification, and the cause having been made apparent, the prevention is attainable, and, we think, lies now in the hands of the public themselves.

THE PRECIPITATION OF SILVER BY COPPER.*

By ALFRED TRIBE, F.C.S.

WHEN a piece of copper foil is metallically connected into a piece of silver, and placed into an aqueous solution of cupric nitrate (dilute to about 6 per cent) containing air, the oxygen of the latter slowly combines with the copper of the nitrate, forming cuprous oxide, which deposits on the silver in a fine crystalline condition, whilst the nitric element combines with metallic copper, reproducing the nitrate. If the copper have its surface covered with crystalline silver, the decomposition of cupric nitrate by free oxygen is accelerated, so much so that, when this couple is moistened with the salt and exposed to air or oxygen, the tips of the silver crystals become at once coated with cuprous oxide; and when a limited quantity of air is used, nitrogen only remains in the free condition (Gladstone and Tribe, *Proc. Roy. Soc.*, vol. xx., p. 290).

In carrying out the above and other experiments, it was frequently necessary to completely precipitate silver from the nitrate by copper, and it was observed that the metal so obtained, after being washed with water, invariably contained copper, sometimes in considerable quantity. Since the above-mentioned couple is formed the instant silver in solution is brought into contact with copper, the idea suggested itself that the copper found in silver precipitated by that metal might be due to dissolved oxygen in the silver solutions; or to the absorption of that gas, by the liquid, from the air during or subsequent to the precipitation of the metal. The experiments made with the view of ascertaining the correctness of this supposition are tabulated below.

There was employed in each experiment an excess of copper, and in experiments C to I about the same volume of liquid. In A and B, pieces of copper of the same dimensions were placed in open basins and covered to about a quarter of an inch with ordinary silver nitrate, *i.e.*, impregnated with air. In C, D, and E, bottles were filled with ordinary silver solution and stoppered during the precipitation. In F and G, carbonic anhydride was bubbled through the solutions prior to the immersion of the copper plate, and the precipitation conducted as in C, D, and E. In H and I ordinary solutions were employed.

* Read before the British Association, Brighton Meeting, Section B.

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Experiment.	Per cent of $AgNO_3$ in Solution.	Duration in Hours.	Copper in Precipitated Metal.	Copper per 100 parts of Precipitated Metal.
A.	1·4	24	0·0185	7·45
B.	1·4	48	0·0377	15·23
C.	3·5	24	0·0103	0·32
D.	1·4	24	0·0096	0·77
E.	0·7	24	0·0099	1·61
F.	3·5	24	0·0025	0·08
G.	1·4	24	0·0029	0·23
H.	3·5	½	merest trace	—
I.	3·5	1/15	" "	—

It appears, from experiments A, B, and D, that the quantity of copper is increased by exposing the couple covered with a solution of cupric nitrate to the air, and diminished by precipitating in closed vessels. The actual amounts of copper in C, D, and E being nearly the same, indicate that its presence cannot be attributed to oxygen in the copper employed; and, moreover, is a result which would follow were it caused by dissolved oxygen in the silver solutions, since it is probable they each contained about the same quantity of the gas. Experiments F and G show that the effect of saturating the solutions with carbonic anhydride prior to precipitation is to diminish the amount of copper three to four times, which doubtless is due to the partial displacement of oxygen by the more soluble gas. In experiments C to G, there existed a trace of silver in solution after the twenty-four hours. H and I, being of short duration, an excess remained; and it is noticeable that, in every case where the silver was nearly exhausted, copper was found, whereas, where there was an excess in solution, the merest trace only of copper existed in the precipitated metal.

It appears from the foregoing experiments that free oxygen is intimately connected with the presence of copper in silver precipitated by that metal; but, whether copper exists therein as cuprous oxide or as basic nitrate, would depend upon at what stage of the operation the oxygen plays its part. If the two actions, *i.e.*, decomposition of silver nitrate by copper, and cupric nitrate by oxygen, be simultaneous, basic nitrate should be found. If, however, the decomposition of cupric nitrate be not effected until the silver nitrate is so exhausted as to be incapable of action on the produced cuprous oxide, that substance should be found. One experiment made on this point with a weak solution of silver nitrate, seemed to show that basic nitrate of copper did not exist.

INFLUENCE OF CHANGES IN BAROMETRIC PRESSURE ON ANIMAL LIFE.

M. BERT continues, in *Comptes Rendus*, his account of researches on this subject.

Having previously shown that the effects produced on animals by changes in barometric pressure were due almost exclusively to the action of the surrounding oxygen (where the air was not confined), he proceeds to describe some experiments with reference to the effect of diminution of pressure on gases contained in the arterial blood.

His mode of experiment was, briefly, as follows:—The animal (a dog) was put in a sheet-iron chamber having several light ports, and fastened to one of its sides. An artery was uncovered and pinched (so as to interrupt the flow) by pincers which could be manipulated from without the chamber. A tube was introduced into the artery, and it extended to the outside, giving a passage for the blood. The chamber was then carefully closed, and the pressure gradually diminished with the aid of a steam-engine. By an arrangement of tubes and cocks, a current of air chemically pure could be kept up about the animal. The pressure in the apparatus could be reduced to 15 centimetres.

The blood was withdrawn with the aid of a syringe connected with the artery-tube, the pincers having been opened. M. Bert here points out an accident which precautions must be taken to avoid, viz., the passage of air into the animal from without, when the pressure has been reduced to a certain point.

The artery chosen was generally a carotid, sometimes a femoral, and the idea that there is a great difference in the blood of these arteries, as regards richness in oxygen, is considered by M. Bert erroneous.

The gases were extracted from the blood by M. Alvergniat's mercury-pump.

M. Bert gives a table of numbers, showing (in cubic centimetres) the volume of the gases per cent (centimetres) of the blood for various pressures. He makes the following inferences from the numbers obtained:—

(1). When the pressure diminishes, the quantity of gas contained in the blood also diminishes. Hence, when a man rises in a balloon, or climbs a mountain, the quantity of oxygen in his blood, for animating the tissues and compensating expenditure of force, becomes smaller and smaller, and, by and bye, insufficient, so that he cannot pass a certain limit without asphyxia. A similar diminution takes place in the carbonic acid, though the consequences of this are not so intelligible. It is at least an erroneous assertion (sometimes made) that the functional sufferings experienced on high mountains are due to intoxication by carbonic acid dissolved in too great proportion in the blood, seeing the proportion of this gas always diminishes with the barometric pressure, whatever the animal's motions.

(2). The diminution in the proportion of oxygen becomes manifest from 20 centimetres' diminution of pressure. And yet these are conditions in which millions of human beings actually live, *e.g.*, on the Mexican plateau of the Anahuac. They are, to use the expression of Dr. Jourdanet, who has studied the physiological effects of such conditions, *anoxyemics*; and the objections which have been urged to his ideas regarding them fall away before direct analysis of the gases in the blood.

(3). In most cases, the oxygen diminishes in greater proportion than the carbonic acid. But there were, in this respect, and in respect of absolute diminution, differences in different animals which are not easily explained: differences which doubtless exist in human beings also, and may partly account for the fact that some men can bear with impunity diminutions of pressure under which others become ill and unfit for work. Taking, as an example, a pressure of 36 centimetres, the loss of oxygen was, in four separate cases, 36, 38, 42, and 56 per cent. Carbonic acid presents more irregularities than oxygen.

(4). The chemical combinations of gases in the blood are dissociated very readily, and in a progressive manner, under the influence of diminution of pressure, and it is remarkable that such diminution takes place more readily in the organism than in experiments made *in vitro*.

M. Bert has hitherto treated of gentle and gradual changes of barometric pressure. He next makes a digression to consider the dangerous consequences of sudden changes in the direction of *decompression*. The fact of such danger is well known in the experiences of workmen who work under pressure, such as divers, who, in many cases, have suffered sharp local pains, paraplegia, paralysis, and even death from this cause. M. Bert cites two explanations which have been given of such effects. One is that of M. Rameaux, who considers that the normal gases of the blood, being dissolved in greater quantity in the liquid at high pressure, return to the gaseous state when the pressure is reduced, obstructing the passage in the blood vessels, and causing the same danger as an injection of air into the veins. M. Bouchard takes a different view; he thinks that when the intestinal gases, diminished in volume through pressure, and replaced in part by the blood, which then tends to the abdomen, expand suddenly on decompression, the blood is violently driven through the circulatory system, and the sudden irruption produces

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in various organs, especially the nervous centres, apoplexy and congestion.

M. Bert put a healthy cat in a large receiver, the pressure in which was then raised to 8 atmospheres in about half an hour. A large cock was then suddenly opened, and equilibrium ensued in a few minutes. The apparatus was opened, and the animal came out apparently uninjured; but in about ten minutes it was seized with complete paraplegia, along with paralysis of the bladder. The urine contained blood and spermatozoids. Next day, this state continued, and the paralysis made progress. The animal was then killed, and the dorso-lumbar region of the spinal cord was found soft, like cream, without, however, any trace of sanguineous effusion or congestion.

Having in no case met with such a state of the nervous centres as M. Bouchard's hypothesis supposes, M. Bert also found the other hypothesis confirmed by the observation of numerous small bubbles of gas disengaged in the blood on decompression. He analysed this gas, and found it composed of 70 to 90 per cent nitrogen, the rest carbonic acid.

According to the pressure, and the rapidity of decompression, the gas may be suddenly liberated in large quantity, or may only pass to the aëriform state by bubbles more or less numerous. In the former case, circulation being arrested, death ensues almost instantaneously, the animal giving some cries and convulsions. The heart and vessels (especially the right side of the heart and the venous system) are then found filled with a kind of froth. The capillaries are injected with gas.

In the latter case, the phenomena vary according to the point at which the gaseous bubbles come to arrest the circulation; sometimes there is only a temporary pain, or failure of locomotion; but very often there was paraplegia, or paralysis, or cerebral disorder, with rolling of the eyes and symptoms of madness. Sometimes even death took place.

In no case in which paralysis had lasted more than an hour was it curable, though the animal sometimes continued to live eight days after. On examination, it was always found that the dorso-lumbar region had been the first attacked, the spinal cord being then softened. The rapidity of this softening, through arrest of circulation, M. Bert considers an important fact for pathological physiology. When the pressure did not exceed 5 atmospheres, decompression might take place in two or three minutes without apparent injury; from 6 atmospheres disorders were caused, and from above 7 atmospheres these always became fatal. When the maximum pressure of the apparatus was produced (19 atmospheres), paralysis and death could not be avoided, unless by extremely gentle decompression. Five minutes per atmosphere was not sufficient to prevent serious injury. Slight and short paralysis was sometimes even caused in a decompression of ten minutes per atmosphere, in descending from 10 atmospheres to the normal pressure.

The foregoing facts, obtained from experiment with dogs, cats, and rabbits, may, to a certain extent, be applied in the hygiene of divers and others working under pressure. Thus, for about 3 atmospheres sudden decompression is not very dangerous, but from 5 atmospheres the danger increases rapidly; and if divers are brought rapidly up from a depth of 70 or 80 metres, the consequences may be fatal.

Returning to the composition of gases in the blood, M. Bert gives the results of experiments in which animals were subjected to pressures above the normal. A dog was fastened in the interior of a metallic chamber, in which the pressure could be raised to 10 atmospheres at a rate of about five minutes per atmosphere. The blood was drawn from the carotid by a method similar to that already described. Such blood was always redder than the blood from the same part at normal pressure; and from about 4 or 5 atmospheres upwards it contained a number of small inflated bubbles.

The gases were afterwards extracted, and a table o numbers is given, from which M. Bert makes the following deductions:—

(1). The richness of the blood in oxygen increases with the pressure; but the increase is very small, and contrasts with the diminution of oxygen where the pressure was diminished. This would seem to indicate that the combination of oxygen with hæmoglobin is at the maximum of saturation, when the pressure is about normal; and for higher pressures, the small additional quantity of oxygen is probably dissolved in the plasma.

(2). The proportion of carbonic acid is not at all affected by increase of pressure; though, as has been seen, it diminishes when the pressure is reduced. M. Bert explains this by the decrease, in percentage proportion, of the carbonic acid in the pulmonary cavities when the pressure is increased, so that its pressure remains the same, and therefore also the quantity of carbonic acid which it maintains in the blood continues the same. In the opposite case (of pressure reduced), the carbonic acid in the lung cavities decreases in pressure, and this is not compensated by increase in percentage proportion.

(3). The proportion of nitrogen increases considerably with the pressure, without exactly following Dalton's law.

A. B. M.

PYRO-GILDING AS COMPARED WITH WATER-GILDING.

By J. BAYNES THOMPSON.

THE older method of gilding by means of gold amalgam (called water-gilding) produces excellent results—the colour is beautiful and the coating is lasting; but it has its drawbacks, as most things have—it is a dear method as compared with others, and it is unhealthy for the manipulator on account of the mercury fumes; moreover, it is only applicable to metals that will amalgamate, and therefore is not applicable at all to iron or steel.

When electro-gilding was first discovered, it was thought that this cheap and easy method of gilding would supersede the more expensive and unhealthy method of gilding by means of gold amalgam. This might have been so, and the electro-process did nearly supersede it at first, till it was found out that it was possible to put a mere film on the surface, and that a mere film only was usually put on. though this film could be made to look at first as well as that done by the older process of water-gilding; but there was usually not one-twentieth of the wear in it, not only on account of its thinness, but also on account of its softness. By the old amalgamating process it was not possible to put a film on the surface, for the gold was amalgamated into the surface of the article gilded, and if too small a quantity of the amalgam was applied, then on "burning-out" the mercury, the gold was hidden in the metal of the article gilded, so that there must be a sufficient quantity applied to stand the "burning-out" of the mercury. This is the reason why the under metal does not tarnish through water-gilding as it does through electro-gilding and the older wash-gilding. In fact, electro-gilding has so degenerated, that no better results are expected from it than from the old dipping process, which is simply depositing a film of gold on the article by chemical action through dipping it in a solution of gold that will act chemically on the article. But iron and steel cannot be gilded by dipping, though it be in a solution of gold which will act on the iron or steel, because the gold is thrown down in powder with the salt of iron mixed with it, and will wipe off. Though gold and most other metals can be deposited in a reguline form on iron and steel, as indeed they can on black-lead and other forms of carbon, yet the coatings will not adhere, for the reasons before stated in a description of pyro-plating. Now, if a sufficiently thick coating of gold could be afforded to make an independent sheath to

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the article, it would then not come off till ruptured, though it would be still only a loose sheath, and would be a very bungling expedient; moreover, it is out of the question as regards gold and the other precious metals.

With copper this can be afforded; therefore it is resorted to when it is required to gild or silver iron or steel. But such articles are with difficulty polished without raising the coating; and if polishing be successfully accomplished, very shortly the coating blisters up, from the gases generated under it by the action and reaction of the copper, iron, and the salts between them, which always remain less or more according to the cleanness and porosity of the iron.

Thus it is seen that no method of gilding hitherto in use is applicable to steel or iron; but, for all metals that will amalgamate, no process is superior in result to water-gilding when a gilding thickness only is required, but then the cost is great and the process unhealthy. When a thicker coating is required on amalgamating metal, then the electro process or the pyro process may be used. Good results may be obtained by the electro process if carefully and conscientiously done; but by the pyro process good results must be obtained, for the gold is then put on in successive coatings, and each coating is burnt in before the succeeding coating is put on. By this method, there is no danger of the gold peeling after being finished, for if the process is not thoroughly carried out, it will peel in the furnace long before the heat is raised to 500°.

This method recommends itself more especially for gilding or plating with gold on iron and steel, as there is no other that will accomplish that; and it is superior for other metals, in some points, to any other process, to water-gilding in cheapness and healthiness, and to other methods in results.

The mode of operation is similar, in most respects, to pyro-silvering, which was described in this journal some time ago. The only difference is this: the gold is put on in successive coatings, while the silver is all put on at once. Even it is better to put silver on in successive coatings in many cases, and it is sometimes done, but it enhances the price of coating too much to be generally practised with silver; in the case of gilding it is absolutely necessary.

The process is this:—After the article has been thoroughly cleaned, mechanically and chemically, the first coating of gold is put on, which, to all appearance, is a perfect coating; but when it has passed through the furnace, if the article be of steel or iron, the gold has disappeared into the steel, &c., which appears just slightly tinged with yellow. The next coating, after being burnt in, changes from brilliant gold to a much paler tint; but the third coating comes out of the fire as brilliant as it went in, and this is the test that the gilding is complete. For gilding, nothing more is required but a good hard burnishing with a steel burnisher to harden and polish the gold; but if, for any special purpose, a thicker coating is required, as many more coatings are put on as are deemed necessary.

THOUGHTS ON THE CONSTITUTION OF MATTER.

By CHARLES THOMAS KINGZETT.

Chemistry teaches us that there are met with in nature sixty-five kinds of elementary matter; but it does not limit the number to sixty-five, as there may be elements as yet unknown—and there are two properties at least common to all elements, viz., weight and form.

It being one of the objects of chemistry to show the relations existing between different bodies, it was not at all unnatural that Prout should have pointed out what he considered to be *one* of these existing relations, which was "that the numbers which represent the combining proportions of the different elementary bodies are multiples by whole numbers of the combining proportion of hydrogen;" and the experiments of Dumas seemed to justify, to a certain extent, Prout's idea, although more recently Stas, by a series of most careful experiments, arrived at a different conclusion, viz., that there is no simple relation between the atomic weights. However this may be, one cannot help reflecting on other existing relations between elementary bodies, and thinking with Miller ("Inorganic Chemistry," vol. ii.), "it is not absolutely impossible that the various bodies at present regarded as elementary may, in reality, be compounds of a single primordial substance condensed in different degrees in the various so-called elements." And it is remarkable that this idea, in a modified sense, has existed in the minds of many of the greatest philosophers throughout all ages.

I now propose to state some of the considerations that lead to the conclusion that all matter, simple or compound (so-called), is constituted of one element under different molecular forces. We say that *this* body is different to *that* body because we know the properties of each are distinct or peculiar; but if by some operations a certain substance had its properties changed, the question arises, Should it be still regarded as the original substance?

Now, by the passage of electric sparks through moist air or oxygen, a body is formed which has a peculiar fishy smell, great oxidising power, and various other peculiar characteristics. In short, it is *transformed* into ozone, or the same matter under different molecular forces. And why should we question it as a transformation? for if a force, or forces, can cause the union of two elements, and the compound formed is no likeness of its constituents, why may not a force, or forces, act on *one* matter or element, and the resultant bear no likeness to the original matter?

Again, magnesic borate ($3MgO\text{-}4B_2O_3$), as found in nature, has no developed electric power; but, when it is heated, it is rendered electric. Here, then, a new property is conferred upon it. By some other methods, known or unknown, a second new property might be assigned, and a third, and so on till all its natural properties by which we originally knew it were changed. Should it still be regarded as boracite? I think not.

It is needless to multiply instances, as many parallel and more convincing cases will suggest themselves.

A second consideration, which leads to the conclusion that there is only one primordial substance, is the fact that many simple bodies have properties very much like those of each other. To quote the words of Miller, in regard to the halogens, "it is impossible not to be struck with the close analogy presented by the three elementary bodies, chlorine, bromine, and iodine, both in their uncombined state and in their compounds. The specific gravity, fusing-point, and boiling-point of these elements rise as the atomic weight increases," and "the intensity of their chemical activity decreases as the combining number increases."

See, also, how the metallic bodies fade into the non-metallic bodies, and animal life into vegetable life!

Such and other evidence seem to lead us to consider all the simple known and unknown substances to constitute a series, each member being connected or related to the next by a tie, or ties, and having, as a whole, a gradation of certain properties; each being composed of the same and only elemental matter, but each being differently operated upon by natural molecular forces. So that, on this view of matter, a compound would be formed by a uniting force between two or more such differently operated upon portions of elemental matter.

But then we are conflicted by the question sure to be asked, How do you suppose matter to have been operated upon so as to form different kinds? The answer is found in the fact that the forces which constitute the cause were created at the same time as matter was, for, as Dubois Reymond has said, "separately they do not exist."

"No force without matter: no matter without force," is an axiom; and this brings me to another point, viz., of

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the interchangeableness of the forces. Heat can be changed into light, and electricity into heat, &c.; and if force admits of transformation, why should not matter, especially when we consider that matter and force are inseparable? It is pleasing to think that perhaps, after all, the dream of the old alchemist was not so wild as it is thought to be; and still more pleasing is it to think that some day it may possibly be realised.

But to return to the subject, iodine, when united with potassium as potassic iodide, will not form with starch its blue iodide; but, if chlorine-water be added, it is immediately formed. Why is this? Simply because when iodine is used, as in potassic iodide, it is under a peculiar force known as chemical affinity, which masks the property that it possesses when free. And so the original properties of elemental matter are merely hid, or modified by the play of the various forces; literally, therefore, oxygen is not an element solely, but an element *plus* the various forces that bestow upon it those properties which enable us to recognise it as oxygen, and distinct from hydrogen, &c.

The diamond, graphite, and charcoal are constituted of the same matter, though the qualities of each are very different—the difference arising from molecular arrangement, or in other words, from the ultimate particles being differently operated upon.

Finally, let us glance at isomerism in the sphere of organic chemistry. The radical methyl is CH_3. Ethylic hydride is C_2H_6. From methyl we can produce its compounds, but we cannot produce them from ethylic hydride; and yet the ultimate composition of the two bodies is the same. Yet we can burn all three forms of carbon into carbonic acid.

Again, propylic alcohol is isomeric with acetone, but yet they are not identical in their properties. So that, if it were asked, Why should some portions of elemental matter be operated upon so differently from others? it might be replied, For the same reason that you cannot get the compounds of methyl from ethylic hydride, and for the same reason that propylic alcohol and acetone are of the same composition and yet so different from the chemists' standpoint.

So that, on the supposition that all forces could be withdrawn, we should have matter reduced to simplicity.

DETERMINATION OF COMBINED CARBON IN STEEL BY THE COLORIMETRIC METHOD.*

By J. BLODGET BRITTON.

IN the *Journal of the Franklin Institute* for May, 1870, there is published a description of a colorimeter, together with a modification of the method proposed by Professor Eggertz, for determining combined carbon in iron and steel.

An instrument of the kind there described, but of a little higher range, though in other respects not differing materially from the one originally made and used in the Iron-Master's Laboratory, I now submit to your inspection; and I propose, also, to make some determinations with it for the purpose of showing how quickly they may be made, and enabling you to form some judgment of what reliance can be placed in the results.

Professor Eggertz proposed only a single standard, and the solution to be tested should be diluted to exactly correspond in colour with that of the standard, and the per cent of carbon calculated after carefully noting and making allowance for the measures of water used in diluting.

In practice, difficulty was found in bringing the colour of the normal solution down to the exact shade of the standard, also other difficulties were met with in conducting the process, causing delay, and interfering with the accuracy of the results.

To materially overcome these, and after numerous attempts, an instrument such as is now before you suggested itself to me; and also I concluded to use a larger quantity of metal than directed by Eggertz, and in addition, to filter the solution from its insoluble matter before making the comparison; and, more recently, to use an acid of just such strength as would completely dissolve the metal without the application of heat. Experimenting with these changes from the original method, I obtained reasonably good results.

The instrument, you will observe, consists of a series of tubes, sixteen in number, two and a half inches long, and about half an inch in diameter, standing upright, and securely fastened in a light, portable walnut-wood frame, but separated one from the other so as to allow just sufficient space between, to place for comparison the tube containing the solution to be tested. The tubes are filled with water and alcohol coloured with roasted coffee, and hermetically sealed. The solutions have been accurately standardised; the one in the tube to the left has its colour to correspond exactly with one produced by 1 grm. of iron containing 0·05 per cent of combined carbon dissolved in 15 c.c. of nitric acid. The solution in the tube next to it has its colour to correspond with one produced by the same quantity of iron dissolved in the same measure of acid, but containing 0·07 per cent of combined carbon; and so with each of the other tubes increasing 0·02 per cent of carbon, coloured in regular succession to the right, the last reaching 0·35 per cent, as indicated by the figures on the upper rail of the instrument.

On the back of the instrument strong pure white paper is tightly stretched for the purpose of screening and diffusing the light, and making the difference in the shades of colour most apparent.

The process of making a determination is exceedingly simple, and may be completed in thirty minutes. 1 grm. of the metal finely divided, is put into a tube of about an inch and a half in diameter, and 8 inches long, with 15 c.c. of chemically pure nitric acid of 1·42 sp. gr., and 2 parts water. The solution is then filtered into a small tube of 4 inches long, and of precisely the same diameter as those in the colorimeter, and as soon as the temperature has become reduced to that of the atmosphere, the tube may be placed in the instrument, the comparison made, and the percentage of carbon at once read off.

While conducting my experiments I found that with three determinations there was usually no perceptible variation, though sometimes there was as much as 0·01 or 0·02 per cent due mainly to some of the metal remaining undissolved. I consider it important, however, that the operator should make his determinations always with a uniform weight of metal and measure of acid, and under like circumstances, and the same as when he made his standards. The acid used should be invariably of the same strength. A very strong acid acts imperfectly on the metal; one not quite so strong acts too violently, and causes too much loss of colour; while, on the other hand, a very dilute acid leaves much of the metal undissolved. I have obtained good results from one of the strength already indicated. From twenty to twenty-five minutes is usually sufficient time to dissolve the metal, and from three to five minutes more to filter. The metal should be in moderately fine division, and passed through a sieve of about 20 spaces to the inch, to insure a pretty uniform size of particles, and about the best suited for being acted on by the acid. The solution, which always becomes quite warm from the action of the acid on the metal, should be allowed to cool to the temperature of the atmosphere, and the colour to become fixed before the comparison is made; the cooling may be hastened by immersing the lower end of the tube in cold water; but a considerable time should not be lost, for after some hours,

* Explained and conducted before the American Institute of Mining Engineers, at the New York Meeting, May 22, 1872.

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and sometimes less, a change occurs, and a gradual loss of colour becomes apparent, and for this reason a nitric acid solution of metal cannot be used for a standard.

I think that by observing these precautions, the operator can, after a little experience, obtain results by the method described, and with the so-called mild steels, sufficiently accurate for all ordinary metallurgical purposes, and, by using a number of tubes at the time, make more than a dozen determinations in an hour.

The speaker then proceeded, in the presence of the members, to make three determinations according to the method he described. When the solutions were filtered and ready for comparison, Professors T. Sterry Hunt and G. W. Maynard were asked to make the comparisons, and declare the results. The solutions were found to be alike in colour, and to be between 15 and 17 of the instrument. The amount of carbon in the metal had previously been accurately determined by another method, and found to contain a little over 16 per cent.

The speaker concluded his remarks by stating that he had carefully tried several of the combustion methods, but had found the one known as Ullgren's, with some modifications, to afford the most constant and reliable results, and he preferred it, in his own practice, when a high degree of accuracy was necessary.

ON DYES AND DYE-STUFFS OTHER THAN ANILINE.*

By Dr. F. CRACE CALVERT, F.R.S.

(Continued from p. 117).

Quercitron, Fustic, Persian Berries, Weld, Aloes, Turmeric, Annatto, Ilixanthine, Lo-kao, Tannin Matters—Gall Nuts, Sumach, Divi-Divi, Myrobalans, Catechu.

I SHALL have the pleasure of devoting the first part of this lecture to some of the most useful and important yellow substances used by dyers and calico-printers, and to one or two other colouring matters which, although scarcely commercially important, are interesting from a scientific point of view.

Among the most valuable of these bodies is *quercitron*, the bark (from which the epidermis has been removed) of a particular species of oak, called the *Quercus nigra* or *Quercus tinctoria*. This tree is indigenous to the United States of America, and is especially found in the forests of Pennsylvania, Georgia, and in North and South Carolina. A chemist, of the name of Bancroft, first introduced it to the English dyers in the year 1775. The most esteemed qualities are those imported from Philadelphia, New York, and Baltimore. The bark, after being removed from the tree, is dried, and ground between mill-stones. The value of a sample bears a direct ratio to the fineness of the powder, for the woody fibre of the bark, which contains only a small quantity of colouring principle, is not easily reduced to a fine powder.

M. Chevreul was the first chemist who examined this dye, and he found it to contain a peculiar tannin, which has since received the name of *quercitannic acid*, and a yellow colouring principle, to which he gave the name of *quercitrin*, but which has since received the name of *quercitric acid* from M. Bolley.

M. Chevreul, by boiling quercitron bark in water, and allowing the aqueous solution to stand, obtained fine, laminated crystals, which were gradually deposited, and to which he gave the name of quercitrin.

M. Bolley followed a better process. He treated the bark by alcohol, precipitated the tannin from the alcoholic solution by gelatine, evaporated the alcohol, and obtained the quercitron under the form of colourless crystals. These, under the influence of air or oxidising agents, assume a bright yellow colour. The alkalies give quercitron a brownish tint, but its most characteristic property is to give a greenish-yellow precipitate with chloride of iron, and a beautiful bright yellow precipitate with protochloride and oxymuriate of tin.

M. Rigaud discovered, a few years since, by boiling quercitron with water containing 10 per cent of sulphuric acid, that it is a glucoside, which decomposes under the influence of the acid into glucose and quercitrin according to the following formulæ:—

Quercitrin.	Water.	Glucose.	Quercitine.
$C_{36}H_{40}O_{21}$	+ $2H_2O$	= $2(C_6H_{12}O_6)$	+ $C_{24}H_{20}O_{11}$

Quercitrin is a crystalline powder, of a bright lemon colour, and of a much richer hue than quercitron. It has no taste, is insoluble in cold water, and only slightly soluble in hot, but is freety soluble in alcohol. It is soluble in alkalies, to which it communicates an orange-yellow hue. Its alcoholic solution gives orange precipitates with the salts of lime, baryta, and lead. It assumes an orange colour with perchloride of iron.

Although quercitron bark gives a fine yellow colour on woollen goods, when mordanted with salts of tin, to which has been added alum or cream of tartar, still its employment has greatly decreased of late years, owing to its colour assuming a reddish hue when exposed to the atmosphere.

Within the last twenty years, a preparation from it has been imported into this country from America, under the name of *flavine*, which in reality may be considered as commercial quercitine. It is now manufactured in England by two different processes. The first consists in boiling half a ton of quercitron bark with 63 lbs. of soda crystals, in about 2000 gallons of water; after boiling for about a quarter of an hour, 250 lbs. of concentrated oil of vitriol are added. The whole is then maintained at the boil for two hours, when it is run off on to woollen filters, washed until free from acid, pressed, and dried, and is ready for market. The second process, which I consider the better one, consists in boiling for two hours 100 parts of quercitron bark with 300 of water and 15 of oil of vitriol, and then washing, pressing, and drying, as in the first process. 100 parts of quercitron bark give 85 of flavine, which have a dyeing power equal to 250 parts of quercitron.

Flavine is not much employed in calico printing as a yellow dye, its principal use being to communicate a brown and orange hue to madder reds.

The best mode of estimating the value of a sample of quercitron bark or flavine, is to dye some mordanted cloth in the same way as in testing the value of a madder or garancine.

We shall now pass to the study of another colouring matter, called *old fustic*. The tree which supplies it is called *Morus tinctoria*, and grows in Madeira, Mexico, Jamaica, Cuba, and other islands of the West Indies. It arrives in this country in logs of various sizes. Dyers prefer those which are dense, are not worm-eaten, and which are of a fine orange-yellow tint in the inside.

In this case, again, my master, M. Chevreul, was the first to isolate the two colouring matters which the wood contained. To the first of these Wagner gave the name of *morintannic acid*, and to the second that of *moric acid*. To extract these, rasped fustic is boiled twice with water and the solution concentrated to the state of a syrup, when after a few days a crystalline deposit takes place, which is separated, washed rapidly with cold water, and pressed. To separate the two colour-giving principles, the pressed mass is treated with boiling water, which leaves the moric acid as an insoluble mass, while the morintannic acid is dissolved. The moric acid is treated with weak hydrochloric acid, to remove some lime salts; it is then dissolved in alcohol, from which it crystallises in the form of yellow needles. To obtain the morintannic acid which was dissolved, the solution is concentrated, when the colouring matter crystallises

* The Cantor Lectures, delivered before the Society of Arts. Revised and communicated by the Author.

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out, and only requires re-crystallising once or twice from acidulated water to give it almost pure. It forms yellow crystals soluble in alcohol, which have the formula $C_{13}H_{10}O_6$. It gives a greenish black precipitate, with sulphate of protoxide of iron, and, with salts of lead, a yellow precipitate, soluble in acetic acid. It is decomposed by concentrated alkalies, and when boiled with zinc and sulphuric acid, the solution assumes a very bright red colour, due to the transformation of morintannic acid into two most interesting substances, *phloroglucine* and *machromine*.

Moric acid, though insoluble in water, is freely soluble in alcohol and ether, but is insoluble in bisulphuret of carbon. It is soluble in alkalies, to which it gives a yellow colour, and from this solution it is re-precipitated by the addition of an acid. Perchloride of iron communicates to its alcoholic solution an olive-green shade. It gives yellow precipitates with salts of zinc, tin, lead, and alumina, and a dark green precipitate with copper. It has the formula $C_{12}H_8O_5$.

Old fustic is especially employed for dyeing wools in yellow or olive-green shades. They are mordanted with a salt of alumina for yellow, or with a salt of iron for green. By the employment of salts of copper and other mordants a variety of shades can be obtained. It is much used by dyers, but only to a limited extent by calico printers.

Young fustic belongs to the same genus as sumach, of which I shall speak further on, and its botanical name is *Rhus cotinus*. It grows in the West Indies, and in France and the southern parts of Europe. It is found in commerce in the form of small logs and crooked branches. Young fustic contains a tannin matter and three colour-giving principles, a red, a brown, and a yellow. The yellow colouring matter, when isolated and crystallised, bears the name of *fustine*. It is soluble in water, alcohol, and ether. Alkalies communicate to it a fine orange hue. It rapidly oxidises when exposed to the atmosphere, assuming an orange colour. A decoction of the wood is affected by the alkalies and air in the same manner as fustine. It gives a bright orange precipitate with lime and baryta waters, and a similar coloured precipitate with chloride of tin. Persulphate of iron yields with it an olive-green precipitate. Young fustic dyes wool mordanted with salts of alumina a fine orange colour, but it is easily affected by light; its chief employment is in conjunction with cochineal, to the red colour of which it imparts a brilliant orange hue. It is much used in Turkey and the Tyrol by tanners to impart to their leather an orange-yellow colour.

Persian berries, which are extensively employed by woollen and mixed fabric dyers, calico printers, paper stainers, and leather dressers, are the berries or fruit of a genus of plants called *Nerprun*, which grows freely in France, Spain, Turkey, Persia, &c. Generally speaking, the berries are gathered before they are quite ripe, which is the reason why the berries, which are the size of a small pea, have a yellowish green shrivelled appearance. The berries only give good results when recently gathered; after one or two years they lose a great deal of their valne, not yielding to the dyer such brilliant hues. The yellower they are, the less price they command in the market. They bear among the dealers the names of the countries from which they are imported; thus there are Avignon berries, Spanish berries, Turkish berries, and Persian berries. The latter are the best, and are obtained from the *Rhamnus amygdalinus*. Among dyers and calico printers all the varieties are called Persian berries.

The yellow decoction of the berries assumes an orange-yellow tint with alkalies, which is not changed on the addition of an acid. Lime-water gives it a greenish hue, persulphate of iron a greenish yellow. Chloride of tin gives a greenish yellow colouration, and a slight precipitate.

Sir Robert Kane succeeded, some years ago, by treating the berries with ether, in extracting a substance, crystallising in fine golden yellow crystals, to which he gave the name *Chrysorhamnine*, and assigned to it the formula $C_{23}H_{11}O_{11}$. He found that, when a solution of this compound was boiled in the air or in presence of an oxidising agent, it became converted into a substance which he named *xanthorhamnine*, to which he gave the formula $C_{23}H_{12}O_{14}$.

Since then, several eminent chemists have examined into the nature of these colouring matters, among whom may be mentioned Gellaty, Bolley, and especially Lefort and Schützenberger.

From their researches the following facts may be gathered. Lefort, in 1866, succeeded in isolating two colouring matters from the berries, which he named *rhamnagine* and *rhamnine*. Rhamnagine is soluble in water, and may be obtained under the form of crystals, while rhamnine is an insoluble yellow amorphous powder. In researches, published in 1869, he found that rhamnagine was identical in composition with rhamnine, and that only a molecular change took place in the transformation of rhamnagine into rhamnine, such as we are all aware starch undergoes on conversion into dextrine. He supported this view by analyses, showing that both these substances had the same formula, namely, $C_{24}H_{32}O_{14}$. The researches of Schützenberger further proved that, under the influence of weak sulphuric acid, rhamnagine is decomposed into a peculiar sugar, and a substance to which he gave the name *rhamnatine*, thus showing that rhamnagine is a glucoside. The following formulæ show the decomposition which takes place:—

Rhamnagine.		Water.		Rhamnatine.		Sugar.
$C_{24}H_{32}O_{14}$	+	$3H_2O$	=	$C_{12}H_{10}O_5$	+	$2(C_6H_{14}O_6)$.

From these results it would appear that the real colour-giving principle is rhamnagine, and that rhamnine and rhamnatine, which are insoluble in water, are only products of decomposition.

Decoction of Persian berries is principally used in print works for producing bright yellows and greens, on prepared tin cloth, in steam styles. To obtain yellows, the extract is mixed either with a little red mordant (sulpho-acetate of alumina), or with a little muriate of tin. The mixture is thickened, printed on, and the fabric is steamed. To produce greens, the decoction of berries is mixed with prussiate of tin, the mixture is thickened and printed on the fabric, which is then steamed, when the yellow of the berries and the Prussian blue which is formed, unite to produce green on the fabric. The decoction of berries is very apt to enter into fermentative decomposition, and thereby become ropy; this may be prevented by the addition of a little carbolic acid.

A very fine brilliant yellow lake is produced from a decoction of Persian berries, the manufacture of which was kept secret for a long period by the Dutch. It consists in adding pure carbonate of lime to the decoction, when the lime salt falls, carrying with it the colouring matter of the decoction. The yellow lake thus produced is moulded into small lumps, which are dried in the shade.

There is a variety of mignonette which used to be cultivated in England and France, called weld, its botanical name being *Reseda luteola*. This plant yields a most valuable yellow dye when fixed on wool by means of alum, not only because the colour is exceedingly brilliant, but because it is very solid, resisting light, heat, and acids. Alkalies only communicate to it a slight orange tint. Its colouring matter was extracted by M. Chevreul many years ago, and he gave it the name of *luteoline*. He obtained it in yellow transparent crytals. By the action of oxidising agents, such as bichromate of potash, it assumes a magnificent yellow tint, indentical to that produced with it in cotton fabrics.

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M. Moldenhauer has since studied luteoline, to which he assigned the formula $C_{20}H_{14}O_8$. It is slightly soluble in water, but very soluble in alcohol. It dissolves without decomposition in strong sulphuric acid, and yields, even when greatly diluted with water, a fine green colour with perchloride of iron. Schützenberger, who has lately studied this body, states that when mixed with water and heated to a temperature of 480° F. in sealed glass tubes, it decomposes into what he considers pure luteoline and resin. The luteoline is found in crystals adhering to the sides of the tube, while the resin collects at the bottom. He states, also, that if a decoction of the berries is boiled with weak sulphuric acid, a new yellow colouring matter is produced, which possesses a high dyeing power as well as a pure yellow hue.

The introduction of quercitron and flavine is the principal reason why weld has nearly disappeared from the market.

Aloes is imported into Europe from Bombay, Barbadoes, Jamaica, and the Cape of Good Hope, in the form of resinous masses, varying considerably in size. It is the dried sap or juice of several varieties of aloes, of the family of *Asphodels*.

Dr. Stenhouse, who has examined this substance, has succeeded in isolating two compounds; one, which crystallises in yellow prismatic needles, is soluble in cold water and alkalies, the solution having an orange tint. It has an intensely bitter taste. He has given it the name *aloïne* and assigns to it the formula $C_{17}H_{18}O_7$.

The second compound, which may be considered as the resin of aloes, has received the name of aloëtine. Dr. Schunck has produced from aloes a yellow dye, called *chrysammic acid*, which will probably be yet extensively used. It is prepared by heating in a water-bath 8 parts of nitric acid with 1 of aloes; when the violence of the action has ceased, a second part of aloes is added. The application of heat is continued until hyponitric fumes cease to be given off. The mass is then poured slowly into a large bulk of water. The chrysammic acid falls in flakes to the bottom of the vessel. These are washed with water, until it assumes a fine purple colour. The formula of this acid is $C_7H_22(NO_2)O_2$. It forms small golden-yellow scales, soluble in alcohol and ether. Although but sparingly soluble in water, it communicates to it a magnificent purple tint, and its dyeing power is considerable. Mr. Saac has made a great number of dyeing experiments with chrysammic acid, and has produced with it a variety of shades. He believes that one day they will become commercial.

Turmeric is the tube or underground stem of the *Curcuma longa*, a plant which grows abundantly in the East Indies. It is imported principally from Bombay, Java, Batavia, and Barbadoes. That from Bombay is the most valuable. It is ground and sold to the dyers in the state of a fine powder of a remarkably brilliant orange hue, and of a strong odour. Vogel and Pelletier succeeded in extracting from it a colouring matter, to which they gave the name of *curcumine*. M. Lepage has, however, given the best process for its extraction. The ground roots are treated with bisulphuret of carbon, which dissolves a volatile oil and resinous matters. The root is then dried and acted on by a weak alkaline solution, which dissolves the curcumine. To liberate it, the alkaline solution is neutralised with an acid, when the curcumine falls as a precipitate. This is collected, dried, and dissolved in ether, from which it separates under the form of small brown scales, which yield on trituration a brilliant yellow powder.

Turmeric is seldom used as a dye, owing to its colour being so easily affected by alkalies, a fact well known to chemists, as they often employ it to ascertain the presence of a trace of free alkali or boracic acid in solutions. It is used in India to flavour rice, and by the natives to colour their skin red.

(To be continued).

OBITUARY.

JOHN CARGILL BROUGH.

It is with no formal expressions of regret that we announce the death of Mr. Brough. That he was a man of great refinement and intellectual culture was evinced by the lability he displayed as Editor of the *Chemist and Druggist*, the *Ironmonger*, the *Year-Book of Pharmacy*, and sub-editor of *Nature*; but failing health rendered it necessary for him to relinquish positions he had filled with so much credit. The promoters of the *Laboratory* could hardly have found a more energetic Editor than Mr. Brough, and in his hands that journal bid fair to become a formidable rival of the Chemical News; in spite, however, of his untiring zeal the *Laboratory* was not successful; but Mr. Brough was ever the most courteous of opponents. Some time before his death he became principal Librarian of the London Institution, and broken in health as he was, he did much to increase its usefulness, and won the esteem of all with whom he came in contact.

NOTICES OF BOOKS.

On Food. By H. Letheby, M.B., M.A., Ph.D., &c., Professor of Chemistry in the College of the London Hospital, and Medical Officer of Health, and Food Analyst for the City of London. Second edition, enlarged and improved. London: Bailliere, Tindall, and Cox. 1872.

The Cantor Lectures delivered in January and February, 1868, by Dr. Letheby, on food, its varieties, chemical composition, nutritive value, comparative digestibility, physiological functions and uses, preparation, culinary treatment, adulteration, &c., were deservedly popular; and we are glad to see that a second edition has been published, now that the work has for some time been out of print. This second edition contains several important amendments, and if possible is even more valuable than the former.

CORRESPONDENCE.

ASSAY OF PYRITES FOR GOLD.

To the Editor of the Chemical News.

Sir,—As you have done me the honour to print in your Journal for August 9, 1872, my article on the "Assay of Pyrites for Gold," I beg leave to say that I hope the method I have there described will be examined by all chemists interested in this kind of work, and that it will be criticised as sharply as it deserves.

On what its value depends I am unable to say. I have sometimes thought that the interior of the crucible being filled all the time with an atmosphere of CO_2, it may be that the sulphur is volatilised in a stream of gas in which it cannot take fire, and that in consequence the gold is not dissipated. Be this as it may, I am sure that this method in skilful hands will show amounts of gold in many iron pyrites, far beyond the belief of most of the assayers who have examined them in the ordinary way.—I am, &c.,

J. M. Merrill

Laboratory, 59, Broad Street, Boston, U.S.A., August 24, 1872.

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MISCELLANEOUS.

Spontaneous Generation of Doctors.—The following letter appears in the *Lancet* for August 17:—

"Spontaneous Generation of Doctors.

"*To the Editor of the Lancet.*

"Sir,—Your able remarks on foreign degrees induce me to request of you a small space to notice the remarkable creation of doctors that has been going on for some time past in the columns of your weekly contemporary, the Chemical News. Almost every foreign name in that journal for the last year or two has the prefix of 'Dr.;' and as many of these German and French gentlemen are personally known to me, I can assure you they would be more surprised than pleased if they saw themselves thus decorated by an unknown hand. British subjects, for palpable reasons, are not so honoured. It is clear that the editor is jealous of doctors generally; and in thus creating an abundant and fictitious flock of foreign doctors, he intends, no doubt, to throw a slur upon the titles obtained at foreign Universities by many of your most distinguished professors, and more especially your distinguished chemists. Pray allow me to expose this practice in the columns of your widely-read journal, and believe me, Sir,

"Your constant reader and obedient servant,

"L. Stein, M.D.,

"Demonstrator of Anatomy in the University of Copenhagen.

"Brighton, Aug. 14, 1872."

It is amusing to find that while L. Stein, *M.D.*, sends this letter to the medical papers, a Th. Kindt, *Ph.D.*, has been sending the same letter to scientific journals (both emanating from Brighton). One gentleman, after reading the letter, took the precaution to look through twenty-six numbers of the Chemical News, and out of 883 names of foreign authors he found only 178 having the prefix of "Dr." We would suggest that the Editor of the *Lancet* should have taken some such precaution, and thus have avoided the publication of untruths. In all cases in which we have given the author of a printed paper the title of "Dr.," the title has been copied from the foreign periodical containing the original article. As, however, the *Lancet* is the only journal which has thought fit to pay attention to the dishonourable insinuations levelled against the Editor of the Chemical News, and as Mr. Stein is evidently anxious that his remarks should be read by the greatest possible number of scientific men, we have had much pleasure in gratifying him by reprinting his letter with its very sensational heading.

The Royal Polytechnic.—An interesting Lecture on "Coal and How to Save it" is now being delivered at this Institution, by Professor E. V. Gardner. In the course of the Lecture mention is made of Stone's Patent for coating steam boilers. This coating is said to effect an economy of one-third in the employment of coal for driving machinery. The Laboratory of the Chemical Department has been reorganised and newly fitted, and is now opened under the direction of Professor Gardner.

Refractory Clays.—Bischof finds that the analysis of a clay gives a distinct indication as to its power of resisting extreme heats. The temperatures were measured by keeping the clay at a white heat till wires of iron or platinum were fused. The value of a refractory clay is found by the proportion of the alumina to the fusible matter, and again by that of the alumina to the silica. The more alumina a clay contains in proportion to the fusible matter (iron, alkalies, &c.), the more refractory is it. Silica, on the contrary, augments its fusibility. Of two clays containing alumina and fusible matter in the same proportions, that which contains least silica is most refractory. Save in certain determinate cases, the clays containing alumina, silica, and fusible matter in equal proportions have an equal power of resisting fire. If we give to clays the general formula, $mAl_2O_3+nSiO_2+RO$, the degree of resistance to fire is measured by $\frac{m}{n}$. The higher the value of this fraction, the more refractory the clay.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, September 2, 1872.

This number opens with excellent speeches from the President, Dr. Faye, and one of the Perpetual Secretaries, Dr. J. Dumas, on the occasion of the presentation of a medal to Professor Chevreul (born August 31, 1786) in consideration of his eminent services to science, industry, arts, and the Academy, during a period of more than sixty years. The eminent speakers give a vivid account of the long and laborious career of the illustrious *savant*, the *doyen* of the Chemical Section of the Academy.

This number contains the following original papers and memoirs relating to chemistry:—

New Method of Extracting the Precious Metals from Copper-Containing Pyrites.—F. Claudet.—The spent or burnt pyrites (Spanish and Portuguese) contains, according to the author, from 0·0020 to 0·0028 per cent of silver (equal to from 20 to 28 grms. to the ton), and, in addition, a small quantity of gold; the extraction of these small quantities might at first sight appear futile, but, as the quantity of pyrites burnt in the United Kingdom alone amounts annually to between 400,000 and 500,000 tons, the extraction of the precious metals therefrom is of importance. The author describes at length a method of operation which is now successfully used in a factory established by him and Mr. J. Phillips at Widnes, near Liverpool; the process is based upon the insolubility of iodide of silver in a solution of chloride of sodium at the ordinary temperature. The burnt pyrites is first ground to powder, sifted, and next gently ignited with some common salt: the ignited mass is, after cooling, treated with dilute hydrochloric acid, and a sufficient quantity of iodide of potassium is added to the clear liquor. In the dry state, the precipitate formed consists, in 100 parts, of—Silver, 5·95; gold, 0·06; lead, 62·28: copper, 0·60; oxide of zinc, 15·46; oxide of iron, 1·50; lime, 1·10; insoluble residue. 1·75; loss and oxygen, 3·62. In the year 1871, at the works above mentioned, 16,300 tons of spent pyrites were operated upon, yielding 333·242 kilos. of silver and 3·172 kilos. of gold, the net value of which, after deducting expense of refining and the loss of 137 kilos. of iodine, was £3230.

Division of One Base between Several Acids when in Solution; Bibasic Acids.—Dr. Berthelot.—The continuation and end of this lengthy essay.

Spontaneous Combustion of a Wooden Beam by the Sole Action of the Solar Rays.—M. Collet.—This short paper contains the account of the spontaneous combustion of a wooden beam in a building at Ribemont (Aisne). The oak beam was found to be on fire during one of the hot days in the summer; it was directly exposed in an open yard to the concentrated heat of the sun's rays; the combustion, although proceeding slowly, was quite distinct, but was not attended with flame; the smoke, however, had a peculiar appearance, and on blowing the wood it burst into flame. The author asserts that the fire was entirely due to the heat of the sun.

September 9, 1872.

This number contains, in addition to several original papers and memoirs relating to botany, meteorology, astronomy, natural philosophy, mathematics, and mechanics, the following original papers bearing upon chemistry:—

Result of the Action of the Sun's Rays upon Various Kinds of Glass.—T. Gaffield.—This paper, to which is added a lengthy appendix by Chevreul, records the results of a series of experiments, continued for several years, on the effect of the sun's rays, and the molecular alterations produced in various kinds of glass by being exposed to these rays for a considerable length of time and under different conditions.

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Induction Currents Developed in Gramme's Electric Machine.—J. M. Gaugain.

New Kind of Urinary Concretion Found in Horned Cattle.—G. Roster.—This paper treats on a peculiar urinary deposit first observed by an Italian veterinary surgeon at Pietra-Santa. The crystalline matter is insoluble in alcohol and ether, and yields ammonia when ignited with soda-lime. It smoulders away without flame when heated upon platinum foil over a spirit-lamp flame, leaving a white, porous, very light ash, soluble in water, but not rendering it alkaline, and found to be magnesia; the composition of this material was ascertained to be $C_{20}H_{26}N_8MgO_{18}$; that is, lithurate of magnesia. The free lithuric acid is a solid crystalline body, fusing at 205°, soluble in boiling-hot water and boiling alcohol, but insoluble in ether.

Annalen der Physik und Chemie, von Dr. J. C. Poggendorff, No. 8, 1872.

This number contains the following original papers and memoirs more particularly relating to chemistry:—

Method of Measurement of the Velocity of Rotating Mechanisms.—A. Schuller.

Researches on Fluorescens.—E. Hagenbach.—The continuation and conclusion of this monograph.

Glacial Formation of the Fjords and Alpine Ice Seas of Norway.—A. Helland.

Remarkable Block of Lava Hurled Upwards by the Late Eruption of Vesuvius.—G. vom Rath.—This memoir treats on the mode of formation and mineralogical characters of a solid piece of lava lately thrown up by the eruption of the volcano.

Researches on the Spectrum of the Aurora Borealis.—H. C. Vogel.

Relation Existing between the Second Axioma of the Mechanical Theory of Heat and the Hamilton Principle.—R. Clausius.

Contribution to our Knowledge on the Thallium Compounds.—C. Rammelsberg.—This exhaustive monograph treats at length on the following compounds:—Hyposulphate of thallium, $Tl_2S_2O_6$: equiv. = 568; percentical composition—Tl, 71·83; S, 11·27; O, 16·90. Iodate, $TlIO_3$; equiv. = 379; in 100 parts—Tl, 53·82; I, 33·51; O, 12·67. Di-iodate of thallium (iodate of sesquioxide)—

$$Tl_6O_{16}+3aq=(TlO_3+3I_2O_5)+3aq.$$

Thallium periodate does not exist; with periodic acid, thallium behaves like iron, manganese, and cobalt, all of which become oxidised to a higher degree, while iodic acid is simultaneously formed. Dithallium periodate. Thallium sesquichloride, Tl_2C_3; equiv. = 514·5; in 100 parts—Tl, 79·3; Cl, 20·7. Dithallium-potassium chloride. Ammonium-dithallium chloride. Potassium-dithallium bromide. Potassium-dithallium iodide. Isomorphism of the thallium salts with that of the salts of monoatomic metals. Perchlorates. Phosphates. Sulphates, seleniates, and chromates. Double sulphates of the magnesian group. Thallium alum, $Tl_6RS_4O_{16}+24aq$. Carbonate, Tl_2CO_3. Oxalates. Tartrates. Paratartrates. Picrates. Cyanides.

Description of an Instrument Contrived for the Purpose of Measuring the Thickness of any Substance.—P. Schönemann.—Illustrated by engravings.

New Shape of the Noë Thermo-Electric Element.—Dr. A. von Waltenhofen.

Pressure and Elastic Shock (Elastischer Stoss).—G. Hansemann.

Annales de Chimie et de Physique, September, 1872.

This number contains the following original papers and memoirs:—

Atmospheric Ozone.—A. Houzeau.—This monograph, elucidated by a large number of tabulated forms, is divided into the following sections:—Historical notices; oxidising power of normal air; smell of normal air; decolourising and disinfectant properties of normal air; meteorological portion; mode of application of semi-iodurated paper; proportion of ozone contained in air; observations made at Ecorcheboeuf in 1863; manifestation of ozone according to the seasons; influence of storms and hurricanes upon the manifestation of ozone; origin of atmospheric ozone.

Researches on Dulcite and on Sugars in General.—Dr. G. Bouchardat.—This memoir, the first instalment of an exhaustive essay on this subject, has been already alluded to from the abstracts published by the author in other periodicals; the full account of every experiment and method of research is here published.

New Process for the Volumetrical Estimation of Copper and of Sugar.—F. Weil.—Reserved for translation.

Synthesis of Orcin, and on some of the Sulphuretted Derivatives of Toluen.—G. Vogt and A. Henninger.—Notwithstanding the high scientific value of this essay, its contents are not well suited for any useful abstraction.

Polytechnisches Journal von Dr. E. M. Dingler, first number for August, 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral subjects:—

Newly-Contrived Water Air-Pump.—C. Christiansen.—The description, illustrated by a woodcut, of a readily-constructed piece of apparatus for use instead of the Bunsen air-pump.

Bunsen Dip (Tauch) Battery.—J. Müller.—This essay is illustrated by a series of engravings.

Validity of the Patent of the Hoffmann Ring Furnace Viewed According to Facts.—Dr. H. Seger.—This memoir, illustrated by several engravings, treats on the legal validity of a German patent. It appears that the invention is an immense improvement in the mode of constructing brick-, lime-, and other kilns.

Composition of the Lyes Obtained by Lixiviation and Oxidation of the Soda Waste for the Purpose of Obtaining Sulphur therefrom.—C. Stahlschmidt.—This exhaustive essay is divided into the following sections:—Introduction; this treats, in the first place, on the process of recovering sulphur from soda waste; it also contains a concise review of the different modes of operation proposed and carried out, and a discussion on the nature and composition of soda waste. Estimation of sulphurous, hyposulphurous, and sulphuric acids. Behaviour of the sulphur lye with sulpharous acid. The author observes that he is not enabled to give precise directions for practical use, in consequence of the variation in the composition of the lyes.

Studies for Establishing a Scientifically-Arranged Tanning Method.—A. Reimer.—The continuation of this monograph; this part of the author's memoir contains the following sections:—Skin (corium) and water; skin and lime and other alkaline matter; skin and acids; skin and tannic acid; skin and chloride of sodium.

Boracic Acid as a Preservative for Milk and Beer.—A. Hirschberg.—It appears that there has been for sale for some time in Sweden, under the name of aseptin, a mixture consisting of equal parts of boracic acid and alum, this mixture being applied for the preservation of meat, and also for protecting it from the injurious action of the oak-wood of the casks in which it is kept. The author states that he found that, by adding 1 grm. of boracic acid to 2 pounds of milk, it remained sweet and fresh in hot summer weather for 120 hours, while milk not so treated became sour and quite useless in 36 hours; the addition of boracic acid to milk does not interfere with its use, but the cream is separated far more slowly. Experiments have shown that beer is improved by the addition of boracic acid, even if it is kept at a comparatively high temperature.

Protection of Wood from Fire.—F. Sieburger.—After first referring to the inconveniences of the application of chloride of zinc and so-called water-glass solution, the author says that it is preferable to first coat or wash the wood twice with a hot and saturated solution of 3 parts of alum and 1 part of sulphate of iron, and next with a more dilute solution of sulphate of iron, to which sufficient pipe-clay has been added to render it as thick as ordinary oil paint. Another method is the following:—The wood is repeatedly painted over with a hot solution of glue, until a very thin coat of glue remains on the surface; then the wood is painted over with a thicker solution of glue, and a mixture of 1 part of sulphur, 1 part of ochre or pipe-clay, and 6 parts of sulphate of iron, is applied to the wood with a dredger, the ingredients having been first separately pulverised and thoroughly mixed.

Le Moniteur Scientifique Quesneville, No. 369, September, 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral subjects:—

Revue des Inventions Nouvelles.—A. Jouglet.—This memoir contains the concise description of a series of some thirty new inventions relating to various branches of industry; those of the inventions which relate to chemical science have been already described in our pages. The author, while briefly alluding to Hemptinne's process for concentrating sulphuric acid in vacuum pans, promises to publish shortly a full account of this invention with its latest improvements.

Manufacture of Ultramarine by One Single Calcination.—M. Fürstenau.—This process is based upon the fact that, when an aluminous white ultramarine is first moistened with a solution of resin in sulphide of carbon, and then ignited over a spirit-lamp in a porcelain crucible, blue ultramarine of great beauty is formed. The mixture to be calcined should contain the elements of pentasulphide of carbon, while the temperature of ignition should be as low as possible. The composition of the mixture to be used on the large scale (woodcuts exhibit the arrangement of the furnace and crucibles) varies somewhat, but the following will, however, give an idea of the composition of the mixture:—Kaolin, previously lightly ignited, and free from undecomposed felspar, 100; soda, 90; sulphur, 110; resin, 10; finely-divided charcoal, 10. The mode of manipulation is described at length, but it appears that the process is attended with technical difficulties, and requires careful workmen to execute it satisfactorily.

Coralline and its Use in Dyeing and Printing.—Dr. Quesneville.—This paper contains an account of the history of invention, present method of preparation, and method of application to cotton and silk fabrics.

Coralline Printing on Woollen Fabrics.—Dr. Kielmeyer.—The detailed description, with receipts for the practical application of printing with coralline on flannels and similar woollen fabrics; the process described is also applicable, with a slight modification of ingredients, for printing coralline on cotton fabrics.

Preservation of Timber.—R. H. Buell, C.E.—This memoir, too lengthy for any useful abstraction, contains an excellent review of all that is known concerning the decay of timber and the causes thereof, as well as a full account of the various processes proposed and used for its preservation.

New Process of Brewing Beer.—A. Jouglet.—The author describes at length, and illustrates with woodcuts, Pasteur's [illegible] improvements in brewing, which will undoubtedly tend to make that

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process more simple, easier to control, and produce a better yield of beer, both as regards quality and quantity.

Researches on the Part which Sulphurous Acid Plays when Employed to Produce the Saccharification and Alcoholisation (Alcoolisation) of Grain, According to a New Method.—V. Hemilian and N. Melnikoff.—Reserved for full translation.

Researches on Chondrine.—Dr. J. Moleschott and A. Rubini.—After referring to the tests given by the late Berzelius and by Dr. G. J. Mulder for albumenoid and gelatinous substances, the authors point out that the precipitate formed in a clear solution of chondrine by acetic acid (albumenoid solutions acidulated with that acid are precipitated by solution of ferrocyanide of potassium, while gelatinous substances are not, under the same conditions, precipitated), is redissolved by the addition of solution of ferrocyanide of potassium; an excess of acetic acid re-dissolves, especially when a gentle heat or boiling temperature is applied, the precipitate first formed by that acid in a clear solution of chondrine. Tartaric acid is preferable to acetic acid for the chondrine reactions.

Gazzetta Chimica Italiana, No. 6, 1872.

This number contains the Faraday lecture, delivered by Dr. S. Cannizzaro, a report of which has already appeared in our pages.

Researches on Trichlorurated Acetal and on Tetrachlorurated Ether.—Drs. E. Paterno and G. Pisati.—After first referring to the labours of A. Wurtz and G. Vogt on this subject, the authors state that they commenced their researches by preparing, according to L. Henry's method, a larger quantity of tetrachlorurated ether. The boiling-point of that body is 189·7°; its density, referred to that of water at 4°, is at 0° 1·4379. When this ether is poured into a glass tube with alcohol, and the tube next sealed and heated in a bath of saturated brine, the result is the formation of Wurtz's and Vogt's trichlorurated acetal, a mobile transparent liquid of an agreeable odour, boiling at 204·8°; its sp. gr. at 0° is 1·2813; its formula is—

$$C_2Cl_3H(C_2H_5O)_2;$$

percentical composition, in 100 parts—Carbon, 32·52; hydrogen, 4·96; chlorine, 48·05; oxygen, 14·47. This essay further treats on the researches of the first-named author on trichlorurated acetal, as obtained some time ago as a by-product of the preparation of bichloracetal by the action of chlorine upon alcohol, the results of which experiments have been published in the *Giornale di Scienze Nat. ed Econ.*, vol. iv., 1867, and on the action of alkaline alcoholic solutions upon tetrachlorurated ether in sealed tubes exposed to a higher temperature, yielding, after purification and fractional distillation, a fluid boiling at 154·8°, having a sp. gr. at 0° of 1·3725, and consisting, in 100 parts, of—Carbon, 27·37; hydrogen, 2·85; chlorine, 60·65. This compound combines with bromine, and forms a body of which the formula is stated to be, in all probability, $CCl_2Br-CClBr.O.C_2H_5$.

Researches on the Detection of Bromine in the Presence of Urea.—Prof. G. Bizio.—This excellent essay is an addition to the author's monograph, published in 1865 (*Atti del Reale Instituto Veneto delle Scienze*), "On the Influence of Urine as Modifying certain Chemical Reactions." Notwithstanding the high scientific value of this memoir, its contents are not well suited for abstraction.

La Revue Scientifique de la France et de l'Etranger, September 14, 1872.

This number contains no original papers relating to chemistry, but is entirely devoted to the record of the proceedings of the opening of the first meeting of the French Association for the Advancement of Science. We find here *in extenso*—(1) The speech of the President, M. de Quatrefages, on "Science and Fatherland (Patrie). (2) An excellent extempore speech by M. Fourcand, the Maire of the ancient and beautiful city of Bordeaux. (3) "History of the Origin of the Association," by M. Cornu. (4) "Report on the Financial Condition," by G. Masson. (5) The reproduction of the telegram sent from Moscow, by the Russian naturalists assembled in the ancient City of the Czars for the purpose of celebrating the bicentenary of Peter the Great's birth, and remembering his merits in reference to science and civilisation in Russia, to the members of the Association at Bordeaux; from this telegram we quote the following:—Le degré élevé que les sciences ont atteint en France est la plus belle conquête de l'humanité; puisse-t-elle prospérer et continuer au bien être général et aux liens internationaux, scientifiques humanitaires." From the reply telegram sent from Bordeaux we quote the following:—"Elle (L'Association) vous remercie donc au nom de la science que nous aimons tous et que nous voulons servir chacun dans sa sphère, chacun dans son pays, car c'est une œuvre de civilisation générale que nous poursuivons avec vous." This number also contains reports of the labours of some of the section meetings, and two lectures relating to military matters given in the general *séances*. Several *savants* from foreign countries attend the meeting.

American Journal of Pharmacy, September, 1872.

This number contains no original papers relating to chemistry or collateral subjects.

The American Journal of Science and Arts, August, 1872.

In addition to several important papers relating to geology, mineralogy, engineering, and natural history, this number contains the following paper relating to chemistry:—

Estimation of Sulphur in Coal and in Organic Compounds.—W. G. Mixter.—The author's process is based upon the combustion of the substances in oxygen, while the sulphur is condensed from the gaseous products in the form of sulphuric acid. The method of operating is fully detailed, and, from the results of experiments, it appears that this mode of determining sulphur in coal and organic compounds is more correct and expeditious than those now in use; the quantity of material operated upon may also be considerably less. Without the reproduction of the woodcut with which this paper is illustrated, the description of the apparatus is impossible.

Bulletin de la Société Chimique de Paris, August 1, 1872.

Synthesis of Parabanic Acid.—M. Ponomareff.—Urea is, according to the author, converted into parabanic acid by the action of that acid and of terchloride of phosphorus, while heat is set free, and hydrochloric acid is developed; the parabanic acid thus obtained is insoluble in alcohol. The aqueous solution yields with ntirate of silver an insoluble precipitate, readily soluble in excess of nitric acid; the formula of this silver salt is $C_3Ag_2N_2O_3$, and the formula of the free parabanic acid is $C_3H_2N_2O_3.2H_2O$ or $C_3H_2N_2O_3.H_2O$.

New Quinine Trical Process.—P. Carles.—Reserved for translation.

Memoir on Phosphoplatinic Compounds.—P. Schützenberger and E. Fontaine.—The continuation of an exhaustive monograph on this subject; it contains lengthy and complex formulæ.

On Camphic Acid.—J. de Montgolfier.—The contents of this paper relate to the rectification of some errors made by Kachler as regards camphic and campholic acids. The author states that Kachler's assertion, that camphic acid is only a mixture of campholic acid and an acid resin, is not correct, and, further, refers to Berthelot's researches on this subject, published in various scientific periodicals. Lastly, reference is made to camphoronic acid, $C_{18}H_{18}O_{10}$, which can be obtained by saturating with ammonia the mother-liquor obtained in the preparation of camphoric acid.

Combinations of Dulcite and Benzoic Acid.—G. Bouchardat.—This essay treats on hexabenzoic dulcite, $C_{12}H_8(C_{14}H_5O_4)_6$, a solid crystalline body, fusing at 147°, sublimable with partial decomposition at 220°, perfectly insoluble in water and in ether, and difficultly soluble in boiling alcohol; when hexabenzoic dulcite is suddenly heated to 200°, and then cooled, it becomes an amorphous mass, entirely soluble in ether; it soon, however, crystallises. Tetrabenzoic dulcitan—

$$C_{12}H_8(H_5O_2)(C_{14}H_5O_4)_4,$$

is also a solid resin-like body, insoluble in water, and nearly so in alcohol; this substance is sublimable without decomposition, and fuses at 150°.

Archives Néerlandaises des Sciences Exactes et Naturelles, Vol. vii., No. 1, 1872.

In addition to purely mathematical and algebraical papers, this number contains the following original memoirs relating to chemistry and collateral subjects:—

Action of Light upon Chlorophyll.—E. Gerland.—This exhaustive essay treats on the combined effect of light and oxygen upon chlorophyll. Among the conclusions drawn by the author we quote the following:—In the presence of air and light the molecules of chlorophyll are submitted to the action of two forces, which tend to alter them, viz., the chemical action of oxygen and the action of light; but, in order to affect any alteration, the joint action of the two is required, as in the dark, unless oxygen is also present, no alteration of the chlorophyll takes place. When a solution of chlorophyll is exposed to the action of air and light, the oxygen combines with the pigment, which thus becomes modified; and when the intensity of the light is sufficiently strong, this action of the oxygen is interrupted, and decolouration of the chlorophyll ensues. If, however, the intensity of the light is weak, the oxidation proceeds, and the pigment is entirely converted into modified chlorophyll. A large portion of this essay is devoted to spectroscopical researches on chlorophyll.

Crystallites, and Crystallogenic Studies.—H. Vogelsang.—This is the continuation of a monograph on this subject, illustrated by engravings exhibiting crystalline substances seen by the microscope.

Agronomic Systems of the Netherlands.—W. C. H. Staring.—This memoir contains information on the rotation of crops, and on the extent of cultivated and uncultivated land, including lakes, marsh ground, and moors, in the Netherlands, and on the divers systems of agriculture. Nearly one-fifth of the entire surface of the kingdom is entirely unfit for cultivation, while more than another one-fifth is meadow land; 28,600 hectares are market gardener's land; 20,000 hectares are orchards; 19,000 are cultivated with tobacco; 14,000 with hemp; 150 with hops (only in one district); and 200 hectares are specially devoted to the cultivation of bulbs of tulips, hyacinths, &c. The total surface of the kingdom is here stated to be 3,289,000 hectares.

Les Mondes, September 5 and 12, 1872.

These numbers contain no original matter or communications relating to chemistry and collateral subjects.

Revue Universelle des Mines, de la Metallurgie, des Travaux Publics, des Sciences et des Arts Appliqués à l'Industrie, May, 1872.

This number contains no original papers relating to chemistry.

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PATENTS.

Communicated by Messrs. Vaughan and Son, Patent Agents 54, Chancery Lane, London, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

2454. W. Ferrie, Airdrie, Lanarkshire. N.B., "Improvements in connection with furnaces for smelting iron."—Petition recorded August 17, 1872.

2491. C. F. Sebille, Paris, France, "Improvements in the composition known as 'schisto-asphaltic and bituminous beton' and novel applications thereof, together with improved machinery or apparatus in connection therewith."

2497. J. R. Roper and A. Alexander, Sheffield, Yorkshire, "Improvements in the treatment of iron and manufacture of steel."—Petitions recorded August 22, 1872.

2515. R. Goodall, Armley, Leeds, Yorkshire, "An improved means or method of, and apparatus for, clarifying impure or waste water from fulling mills, scouring mills or scouring processes, dye-houses, sewage, and other impure waters."—Petition recorded August 24, 1872.

2527. C. Frickinger, Berlin, Prussia, "Improvements in the manufacture of malleable iron and in the furnaces employed therein."

2529. H. A. Duférré, Paris, France, "An improved mode of preserving fruit."—A communication from F. Sacc, Neuchatel, Switzerland.—Petitions recorded August 26, 1872.

2545. C. Morfit, Baltimore, Ma., U.S.A., "Improvements in vats or vessels for the various chemical and manufacturing operations which involve the use of acids."—Petition recorded August 27, 1872.

INVENTION PROTECTED BY THE DEPOSIT OF COMPLETE SPECIFICATION.

2572. W. R. Lake, Southampton Buildings, London, 'Improved compounds, chiefly designed for coating ships' bottoms."—A communication from J. H. Bloodgood, New York, U.S.A.—Petition recorded August 29, 1872.

NOTICES TO PROCE D.

2035. B. Todd, Newcastle-upon-Tyne, "Improvements in the treatment of gases and fumes."—Petition recorded July 5, 1872.

2417. F. D. Blyth, Fenchurch Street, London, and A. G. Southby, New Inn, Middlesex, "Improvements in the process and apparatus for heating wood for the manufacture of pulp for paper."—Petition recorded August 14, 1872.

2431. T. Routledge, Ford Works, near Sunderland, "Improvements in treating fibrous substances for textile purposes, and for the manufacture of paper stock."

2443. W. R. Lake, Southampton Buildings, London, "Improvements in puddling furnaces."—A communication from G. E. Harding, New York, U.S.A.—Petitions recorded August 15, 1872.

PATENTS SEALED.

705. A. F. Andrews, New Haven, Conn., U.S.A., "Improvements in the process of making malleable cast-iron and in apparatus therefor."

715. J. Garneri, Gracechurch Street, London, "A new system or process for the production and decomposition of anhydrous chlorides, and apparatus for those purposes.—Dated March 8, 1872.

958. C. D. Abel, Southampton Buildings, Middlesex, "An improved process for the preparation of acid phosphate or superphosphate of lime."—A communication from G. Ville, Paris, France.—Dated April 1, 1872.

1509. J. A. Froitzheim, Cologne, Prussia, "Improved manufacture of explosive compounds."—Dated May 17, 1872.

1951. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in preserving butter and other fatty matters, and in the apparatus or means employed therein."—A communication from Enault and Company, Paris, France.—Dated June 28, 1872.

2029. B. J. B. Mills, Southampton Buildings, London, "Improvements in sizing paper, paper pulp, cotton, linen, and other fabrics and materials, and in materials to be employed therefor."—A communication from J. MacDorlan, East Brandywine, Penn., U.S.A.—Dated July 4, 1872.

2119. W. R. Lake, Southampton Buildings, London, "An improved gypsum cement."—A communication from E. F. A. Schott, Secsen, Germany.—Dated July 13, 1872.

FOREIGN PATENTS.

UNITED STATES OF AMERICA.

128978. A. E. Reed, "Manufacture of paper."
128992. S. Wheeler, "Manufacture of paper."
128993. J. Wilson, "Furnace for reducing iron ores."
129014. A. Farrar, "Process of refining oil from the acid residuum of oil works."
129044. J. Matthews, "Manufacture of mineral waters."
129114. F. C. Durant, "Treating sugar."
129151. J. D. Marshbank, "Cupola furnace for melting iron."
129153. H. McDonald, "Puddling furnace."
129185. A. T. Sturdevant, "Manufacture of paper stock."
129199. R. G. Wood and J. R. Jackson, "Furnace for the mechanical puddling of iron."
129204. W. Archdeacon, "Preparing wooden vessels for holding acids."
129217. A. K. Eaton, "Compound of gelatine, tannin, and cellulose,"
129243. J. W. Middleton, "Process and apparatus for the manufacture of iron and steel."
129261. G. Whitney, "Metal for castings."
129284. J. Kintz, "Process of colouring tin, zinc, &c., so as to resemble gilding."
129310. P. Bearsch, "Hair restorative."
129341. B. R. Hawley, "Bleaching cane-juice and other liquids with sulphurous acid."
129342. A. Haws, "Medical compound for small-pox."
129343. A. Haws, "Medical compound for cholera infantum, &c."
129417. D. McDaniel, W. B. Spear, and J. W. Richards, "Method of utilising waste tin scrap and galvanised iron."
129430. W. Sellers, "Puddling iron."
129438. C. Toppan, "Process of treating articles to render them waterproof."
129463. S. H. Crocker, "Purification of paraffine."
129469. N. W. Gaddy, "Medical compound for healing wounds, &c."
129503. P. Welch, "Preserving wood."
129517. E. P. Baugh and D. Baugh, "Treatment of horns, hoofs, and other organic matter."
129525. W. T. Bush, "Manufacture of soap for shaving, toilet, &c."
129608. J. N. Smith, "Hair restorative."
129626. H. A. Tilden, "Medical compound."
129645. E. B. Benedict, "Calcinine."
129689. J. W. Snyder, "Manufacture of artificial stone."
129708. M. C. Bland, "Compound for polishing metals, glass, &c.
129720. C. F. Dieterich and A. Schüssler, "Manufacture of illuminating gas."
129732. C. Hefft, "Compound for clarifying beer and other liquids."
129739. D. I. Loewenstein, "Manufacture of fertilisers from night soil."
129753. L. Scala, "Dyeing with indigo."
129762. J. A. Stearns, "Puddling furnace."
129815. L. S. Goodrich, "Process and apparatus for the manufacture of charcoal."
129835. M. H. Kollock, "Preparing wheat for food."
129841. G. Little, "Preparing paper for automatic telegraphy and in recovering chemicals from waste-paper."
129886. W. W. Gardner, "Medical compound for cure of colic, &c."
129899. J. W. Middleton, "Apparatus for producing refined iron and steel castings."
129901. E. Osgood, "Process of rendering leather, fibrous and porous materials impervious to gas."
129937. T. P. Devor. "Cider bitters."
129942. E. Gauvreau, "Medical compound or cough lozenge."
129951. G. W. Harris and H. P. Allen, "Manufacture of illuminating gas."
129997. W. T. Walker, "Apparatus for purifying gas."
130001. O. Zaretusch, "Apparatus for generating carbonic acid gas."
130004. J. D. Averell, "Carburetter."
130044. G. E. Harding, "Puddling furnace."
130091. J. R. Weed, "Article of food."
130114. J. Dupont, "Treating plants to produce paper-pulp and fibre."
130123. C. F. Fuchs and A. Clement, "Gun and blasting powder."
130160. G. Smith, "Hair restorer and colouring compound."
130164. G. Symes, "Apparatus for the manufacture of gas."
130174. J. Young, "Process and apparatus for the manufacture of carbonate of soda."
130200. Z. S. Durfee, "Metallurgic furnace."
130229. A. MacDougall, "Medical compound or ointment for horses' hoofs."
130230. H. MacDougall and C. MacDougall, "Manufacture of glue."
130241. H. A. V. Post, "Apparatus for puddling and melting iron."
130245. J. S. Rosenthal, "Treatment of asbestos for the production of textile fibres."
130263. E. Wilson, "Medical compound or salve."
130277. J. W. Burton, "Treating and refining oils and fats.
130279. J. G. Colcord, "Composition for coating marine cloths."
130282. J. Damken, "Manufacture of condensed wine."
130298. E. N. Horsford, "Manufacture of phosphate of lime and yeast powders."

SAXONY.

3125. E. T. Payen and H. Roux, "A new method of extracting metals, except iron, from their ores."—Dated May 28, 1872.

3144. A. Grell, "Manufacturing stearine and oleine."—Dated June 7, 1872.

TO CORRESPONDENTS.

A. M. Edwards, Newark, N.J.—We will bear it in mind.

H. Townsend.—The work will not be completed for some time to come.

Prof. R. V. Tuson.—Unfortunately your communication did not arrive until we had gone to press.

W. F. D.—We are sorry we did not receive the information earlier. An advertisement would be beneficial.

H. B. Yardley.—As far as we know no such table is published, but it is easy to calculate from the tables of specific gravity of acids.

Sydney Gibbons, Melbourne.—Received with thanks.

Dr. J. Emerson Reynolds.—We are obliged for your communication.

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THE CHEMICAL NEWS.

VOL. XXVI. No. 670.

THE ALLEGED CONVERSION OF ALKALINE SULPHATES INTO CHLORIDES BY IGNITION WITH AMMONIUM CHLORIDE.

By EDWARD NICHOLSON, F.C.S.,
Assistant Surgeon, Royal Artillery; Analyst of Waters, Madras Presidency.

AN error, occurring originally in Fresenius, and copied from it into other analytical handbooks, has come to my notice in a rather peculiar manner. A new scheme (the third) for the analysis of potable waters has lately been inflicted, by authority, on India; and in a local medical journal I criticised it rather severely, though not more so than it deserved, as it is a mere patchwork of processes, many of them good, but picked out of books and put together with little evidence of either practical chemical knowledge or of Indian experience. One of the processes I criticised was the following; it occurs in the process for the determination of alkalies:—

"Add some chloride of ammonium (to convert sulphate of sodium or potassium into the chloride), evaporate, ignite, and weigh the residual chloride of sodium and potassium. If the water contain only a small proportion of sulphuric acid, the addition of the chloride of ammonium will suffice for the conversion of the sulphates into chlorides; but if the proportion of sulphuric acid is large, it is necessary to add at once, before the addition of the milk of lime, a quantity of chloride of barium equivalent to the known amount of the sulphuric acid."

I pointed out that the reaction indicated was an impossible one, and that there was not the slightest ground, *in fact*, for the assertion that sulphuric acid could be thus expelled.

Rejoinders followed, more remarkable for faith in textbooks than for evidence of profit by their teachings; it was pointed out that the process, being copied from Fresenius, must be quite correct. One anonymous representative of Indian professorial chemistry declared that he would rather "go to hell with Fresenius than to heaven with Mr. Nicholson." The author of the scheme declared, more politely, but no less strongly, that he and the authorities were right; he regretted the consequences which my temerity will bring down on me. An apothecary, who is officiating as assistant to the Madras Professor of Chemistry, alone had the happy thought to try the experiment; and he proved most satisfactorily to himself that Fresenius is right, provided that not more than 1 milligramme of alkaline sulphate is operated on; beyond that quantity the spell refuses to work, and the conversion is incomplete.

In consequence of this little episode, I proceeded to examine how far it is possible for ammonium chloride to effect any permanent change in alkaline sulphates.

The following experiments were made with salts of ascertained purity. In each case the mixture was dissolved in a little water, and the solution evaporated down on the water-bath. The ignition was made as rapidly as could be without incurring danger of decrepitation.

(1). 0·0967 grm. of sodium sulphate, ignited with 0·2330 grm. of ammonium chloride. Weight of residue unaffected to within 0·0001 grm. Dissolved in 5 c.c. of water, it gave less than 0·0002 grm. of chlorine. Formation of sodium chloride equal to about 3 parts in 1000.

(2). 0·022 grm. of sodium sulphate ignited twice, each time with 0·010 grm. of ammonium chloride. The residue, dissolved in 2 c.c. of water in 1 c.c. of the amount of sulphate had undergone no perceptible alteration; in the other, silver nitrate produced a slight opalescence, estimated to be equal to that produced in 1 c.c. of a water containing 0·03 grm. per litre of sodium chloride. As nearly as could be estimated on such a minute quantity, the amount of chloride formed amounted to 30 parts per 1000.

(3). 0·010 grm. of sodium sulphate ignited twice; the first time with 0·065 grm., the second time with 0·130 grm. of ammonium chloride. The residue gave 0·0001 grm. of sodium chloride. Conversion equal to 10 parts per 1000.

(4). 0·0324 grm. of sodium sulphate, ignited with 0·0500 grm. of sodium chloride and 0·0840 grm. of ammonium chloride. This experiment would correspond to that performed in the treatment of a litre of ordinary potable water. The loss of weight after ignition was 0·0010 grm.; but this was rather uncertain, owing to the difficulty in weighing sodium chloride accurately in the very damp climate where the experiment was made. Sulphuric acid was determined in the residue, also in 0·0324 grm. of the original sodium sulphate. The results were—

	$BaSO_4$.	SO_4.
Original salt	0·0539 grm.	= 0·0222 grm.
Residue of ignition	0·0537 ,,	= 0·0221 ,,
Theory	—	= 0·0219 grm.

I think these experiments show that, even with very small quantities, there is practically no change effected in the process under discussion. The very partial reaction that does take place is of no use in analysis; the process is an ineffectual attempt at forcible reversion of the ordinary reaction, by bringing a large excess of ammonium chloride to bear on the sulphate. Evaporation and ignition with ammonium chloride only affect the nitrates, carbonates, and silicates present in water, but ammonium sulphate converts all chlorides, nitrates, &c., into sulphates; in fact, sulphuric acid acts just as effectually when guarded* with ammonia as when free. I am rather surprised at seeing this erroneous statement persistent in successive editions of Fresenius.

I intend to investigate the statical points connected with the reaction of ammoniacal salts on alkaline sulphates and chlorides; in the meantime, I think it advisable to draw attention to the error occurring in the handbooks of analysis.

Vizagapatam, June 18, 1872.

ON THE OCCURRENCE OF NATIVE SULPHURIC ACID IN EASTERN TEXAS.†

By J. W. MALLET, Ph.D., M.D.,
Professor of Pure and Applied Chemistry, University of Virginia.

NOT far from the Gulf of Mexico, and within twenty-five or thirty miles to the westward of the Neches river, there occur at several localities—in some instances in the woods, in others in the midst of open prairie—small drainage-wells and shallow pools of water strongly sour to the taste. This sourness is due to the presence of free sulphuric acid, which is accompanied by various salts, especially aluminium and iron sulphates. At most of these points gases are continually escaping (hydrogen sulphide, marsh gas, and carbonic anhydride), the bubbles burning readily on the application of a light.

At the bottom of the water in some instances, as at one point where, by means of an artificial bank, a pond has been formed of some 250 feet in diameter, known locally as the "sour lake," an earthy crust with intermingled

* I use the term "guarded," as it expresses the effect very well. Nitrous waters may be evaporated down with ammonium sulphate without fear of platinum vessels being attacked, as would be the case in presence of free sulphuric or hydrochloric acid.

† Read before the British Association, Brighton Meeting, Section B

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ree sulphur is observable. A thick, tarry variety of petroleum is found oozing from the surrounding soil, occasionally to such an extent that sods taken up with a spade are set on fire and used to give light in the open air at night.

At a point in Louisiana some fifty or sixty miles further East, where, however, the acid water does not occur, though combustible gas and petroleum are met with on the surface, a most remarkable bed of native sulphur, 100 *feet in thickness*, has been reached at the depth of 450 feet by boring, and a shaft is being at present sunk for its exploitation. This large mass of native sulphur is more or less mingled with calcium carbonate, and underlaid by gypsum. The circumstances connected with the occurrence together in this region of combustible gases, petroleum, sulphur, sulphuric acid, and gypsum are of great interest in relation to the mineral history of native sulphur.

The sulphuric acid water, which seems to be probably altogether of superficial origin, is worthy of notice from the unusual strength occasionally attained. The water varies very much at the different localities and at different times. In one instance, a specimen examined by Dr. Mallet contained no less than 5·290 grms. of free sulphuric acid (H_2SO_4) to the litre, or 370 grs. to the imperial gallon, this exceeding any amount hitherto reported from other localities, unless the acid spring of the Paramor de Ruiz, in New Granada, be an exception, examined by Lewy, who does not state precisely how much of the very large quantity of sulphuric acid found is uncombined with bases. The water of the Rio Vinagre, flowing from the volcano of Purace in the Andes of Popayan, as described by Humboldt and Boussingault, contains only 1·11 of free sulphuric acid (SO_3?) in 1000 parts of the water, with 0·91 of hydrochloric acid.

It is said, on the authority of Confederate officers serving West of the Mississippi, that during the blockade of Southern ports the galvanic batteries of telegraph offices in Texas and Western Louisiana were worked with this native sulphuric acid.

NOTE ON A CITRATE OF BARIUM.

By E. SONSTADT.

CHEMICAL text-books describe a class of citrates to which the formula $C_{12}H_{11}M_5O_{14}$ is assigned, and which might be called di-tri-metallic citrates, since the formula may be obtained by addition of the formulæ of a di- and of a tri-metallic salt. As this formula differs but little from the formula of a citrate shown, in my paper on "The Oxidating Power of Iodide of Potassium," to be chemically neutral in reference to a liquid there described, and in which the number of atoms of metal are to the number of atoms of hydrogen as 1:2; it occurred to me as probable that the formula given in the books may have been incorrectly given to salts really constituted according to the formula $C_6H_{5\frac{1}{2}}M_{2\frac{1}{2}}O_7$, or the double of that, $C_{12}H_{10\frac{1}{2}}M_{5\frac{1}{2}}O_{14}$. Since salts of this kind must be prepared for analysis by drying at a temperature not far removed from that at which they begin to decompose, a doubt being thus introduced as to the perfectness of their preparation, it seemed useless to attempt by analysis to establish entirely beyond doubt which of the two formulæ is correct,—especially as the percentage of metal in the two cases respectively can differ but very little in respect to the total weight of salts taken for analysis. But the formula in which the proportion of metal to hydrogen is given as 5 : 11, is satisfied by adding one atom of citric acid to five atoms of a tri-metallic citrate; whereas the formula requring 1 : 2 is satisfied by adding one atom of citric acid to eight atoms of a tri-metallic citrate,—a difference wide enough to admit of very satisfying experiments.

Eight parts by weight of citric acid were exactly saturated by solution of carbonate of sodium, so that the reaction was neutral to litmus-paper. 1 part of citric acid was dissolved in the liquid, solution of chloride of barium added in excess, and then about twice the volume of the liquid of alcohol. The liquid, filtered after a while, was neutral to test-paper, or had only a scarcely recognisable acid reaction. Hence the precipitate of barium citrate formed must have contained the whole of the citric acid employed, and therefore the barium was to the hydrogen in the citrate as 1 : 2. In other experiments, when a larger proportion of citric acid to tri-metallic citrate was used, the alcoholic filtrate was always strongly acid.

Quantitative experiments were now made, in which part of citric acid was taken to 5 parts of citric acid for neutralisation; and, in one case, 3 atoms acid to 10 atoms tri-metallic citrate. Weighed quantities of chloride of barium, adjusted to give neither excess nor deficiency were added; and the acid in the alcoholic filtrates was estimated by a standard alkaline solution. In the first three experiments, the amount of citric acid in the precipitates (over what was included as tri-metallic citrate) was also estimated, by boiling these precipitates with sulphate of potassium in excess, and neutralising the solution by the standard alkaline solution. As the sum of acid found in filtrates and precipitates agreed nearly with the total excess of acid over what was needful to form tri-metallic citrates, in the remainder of the experiments the acid in the filtrate only was directly observed, that carried down in the precipitates being calculated.

In four experiments, in which 5 parts of citric acid were neutralised by soda, 1 part citric acid added, and then chloride of barium in equivalent proportion, and alcohol, the acid in the filtrate to that in the precipitate were—(1) 12 : 28; (2) 12 : 28; (3) 12 : 28; (4) 15 : 25, but in this (4) the experiment was varied by adding the chloride barium to the citrate formed by neutralising the 5 parts citric acid taken, by soda, then alcohol, and *lastly*, the reserved part of citric acid. In experiment (5) 3 parts citric acid were used to 10 parts acid neutralised by soda; or one-third more citric acid than necessary to give the salt $C_{12}H_{11}M_5O_{14}$. The proportion formed in this case of acid in filtrate to acid in precipitate was 28 : 3. If the citrate of barium formed in these experiments had the composition $C_{12}H_{11}Ba_5O_{14}$ there could, in experiments (1) to (4), have remained *no* acid in the filtrates. In experiment (5), it would have been as 20 : 40. The formula $C_{12}H_{10\frac{1}{2}}Ba_{5\frac{1}{2}}O_{14}$, requires the proportion of acid in filtrates, and precipitates in experiments (1) to (4) to be as 3 : 5, or as 15 : 25; and in experiment (5), as 35 : 25. In each experiment, therefore (except in (4) where the proportion agrees with theory), a small proportion of acid over the proportion required by theory was carried down, and the proportion thus carried down was largest in experiment (5), where the citric acid was used in largest excess. It might be supposed that possibly a di-tri-metallic barium citrate may have been formed in these experiments, and that the acid found in the filtrates was due to the solubility of such barium salt in alcohol. In such case, the proportion of barium in the filtrates should be proportional to the acid found in them. In experiment (5), where, evidently if this is so, a larger proportion of barium should be found in the filtrate than in the other experiments, the barium was quantitatively determined, and found a little under 2 per cent of the barium in the precipitate. It seems impossible, therefore, to deduce any other conclusion from these experiments, than that the formula $C_{12}H_{10\frac{1}{2}}Ba_{5\frac{1}{2}}O_{14}$ (and not $C_{12}H_{11}Ba_5O_{14}$) is correct for the salt in question.

I endeavoured to obtain a corresponding ammonium salt, by drying up tri-metallic ammonium citrate on the water-bath. Ammonia, however, was continuously given off, and the glutinous mass remaining, still smelling of ammonia, was found to have parted with nearly half (six-thirteenths) of the ammonia originally contained in the salt. The behaviour of ammonium citrate at the tem-

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perature of boiling water, is therefore comparable to that of ammonium phosphate at a much higher temperature.

When 8 parts citric acid are saturated with soda, and 1 part acid added, a crystallised salt is obtained by long standing of the concentrated liquid, with difficulty. The crystals consist of tri-metallic citrate. It does not appear, therefore, that the salt $C_{12}H_{10\frac{1}{2}}Na_{5\frac{1}{2}}O_{14}$ is crystallisable. But alcohol precipitates from a solution of this salt a dense fluid, and the supernatant liquid is only slightly acid to test-paper.

As the existence of a class of salts containing fractional atoms of base appears inconsistent with the etymological meaning of the word "atom," and opposed to the most commonly received "atomic theory," I propose to carry these researches further as I may have opportunity. Should other tri-atomic acids than citric acid be found to give corresponding salts, the discussion of the theoretical bearings of the existence of such salts will be much simplified, because they can then be viewed apart from the special constitution of a single organic acid which is supposed by some to be derived from a triple molecule.

CHANGES PRODUCED IN THE GLOBULES OF THE BLOOD AND THEIR RELATION TO SECRETIONS.

M. RITTER, of Strasburg, in a recent thesis to the Paris Faculty of Sciences, discusses this question; having investigated the action of the following substances on the blood globules, and correlatively on the excretal humours, viz., oxygen, protoxide of nitrogen, oxide of carbon, compounds of antimony and of arsenic, phosphorus, and biliary acids. We give an abstract of his results.

Action of Oxygen.—Since the discovery of oxygen, its action on the blood and tissues has been studied by various physiologists; to whose works M. Ritter makes reference. MM. Demarquay and Leconte observed that animals could breathe pure oxygen a long time without inconvenience, and that the pulse was sometimes accelerated, and a feeling of comfort produced. Allen and Pepys inferred from experiment that the quantity of carbonic acid excreted increased with oxygenation of the air: but this has been denied. M. Ritter studied especially the influence of oxygen on urinary excretions. He submitted himself to a fixed daily diet, producing a certain quantity of urine, and he compared the urine of days on which he absorbed pure oxygen with that of other days on which he did not do so. In the former case he inhaled 25 to 30 litres of oxygen, inspiring the gas gently from a gasometer, as when one smokes. From analysis of the urine obtained under these conditions, M. Ritter found the acidity increased, the quantity of nitrogen and of urea diminished, the uric acid diminished, and the ammoniacal salts increased considerably. The products were those of advanced oxidation.

This urine obtained after inhalation of oxygen, underwent acid fermentation very quickly, and remained acid for a long time, sometimes not becoming alkaline till after two months; and he asks if therapeutical science might not take advantage of this fact in affections in which the urine has a pronounced tendency to ammoniacal fermentation, and if inhalation of oxygen might not happily modify this morbid property.

M. Ritter did not experience the feeling of comfort referred to by other physiologists; his pulse became less rapid, but fuller, the legs felt somewhat benumbed.

Comparing the urine produced in states of repose and in states of muscular activity, M. Ritter found, that after a state of complete repose, walking produces phenomena of oxidation different from those observed after inhalation of pure oxygen. The quantity of nitrogen eliminated in the urine is increased instead of diminished, and the proportion of urea to uric acid increases nearly one-half.

Action of Protoxide of Nitrogen.—M. Ritter obtained the gas from nitrate of ammonia in a retort placed in an oil-bath heated by gas, so that the temperature of the salt was raised to +230°; the gas being produced at the rate of about 6 litres per hour. It traversed tubes containing litmus, potash, ferrous sulphate, and pyrogallate of potash, and was collected over water from which the air had been expelled by boiling. It could thus be had very pure.

According to M. Ritter, protoxide of nitrogen is a very poisonous gas. For example, a pigeon placed in a receiver containing 80 per cent of the protoxide, died immediately. When defibrinated blood is agitated with protoxide of nitrogen it is reddened as by oxygen; but after some time it becomes bluish-red. M. Ritter considers that the protoxide is first absorbed by the globules and then expelled by the oxygen of the serum.

He experimented with pigeons, rabbits, and frogs, and found that protoxide of nitrogen, mixed with its own volume of air, always diminishes the oxidation, and cannot sustain life. The inhalation of a volume of air containing $\frac{1}{10}$th of protoxide diminishes considerably the quantity of carbonic acid, but without stopping the respiration. If this proportion is reduced to $\frac{1}{30}$th, the quantity of carbonic acid does not sensibly alter. Thus we see that in 50 per cent of protoxide of nitrogen life is impossible; in 5 per cent it is not at all deranged.

Next as to the effect on urinal excretion, M. Ritter drank water saturated with the protoxide, and he found that all the immediate principles of urine were increased; there was diuresis. When the absorption of the gas was continued, the proportion of uric acid to urea rose considerably.

Action of Oxide of Carbon.—M. Bernard has shown that blood mixed with oxide of carbon loses its gases, and especially its oxygen, in a very short time. The oxide prevents hæmatosis, and kills the blood. Examining the effects of this substance absorbed in doses which were not toxical, M. Ritter found diminished oxidation, and the urine to have become albuminous, containing both albumen and albuminose.

Action of Compounds of Antimony.—M. Ritter employed the emetic and sulphuret of antimony, studying their effects on men, rabbits, dogs, and geese. Having taken, for some time, 5 milligrammes of emetic daily, he did not obtain very distinct results on analysis of the urine, but it appeared that the principles of oxidation were somewhat diminished. The same is to be said of dogs, which were given 15 and 20 milligrammes of emetic daily. Their urine did not contain morbid principles.

In some parts of Germany, glass of antimony is mixed with the paste given to geese, with the view of fattening them. M. Ritter wished to test the value of this idea, and found that under the influence of 5 and 10 centigrammes of sulphuret of antimony daily, the sugar and fat of a goose increased very little. There was no alteration in the globules. With stronger doses, the quantity of fat did not further increase. The blood contained less carbonic acid and oxygen.

Action of Arsenious Acid.—The result of experiments, on geese chiefly (the dose of arsenic ranging from 5 to 20 milligrammes) was that small doses produced a considerably greater formation of fat, while strong doses caused emaciation. (M. Ritter believes the custom of giving geese glass of antimony to fatten them, is really based on the fattening effects of arsenic, which glass of antimony always contains). The globules of the blood were only altered by very strong doses. Crystals of hæmoglobin were sometimes met with. In this case the urine was icteric and albuminous. Glucose increased in the plasma. M. Ritter adds, that in his experiments with men, he never met with the colouring and *embonpoint* which are said to result from arsenicophagy.

Action of Phosphorus.—Two milligrammes were given daily to dogs; in 10 or 12 days they became icterically diseased, and were then killed. The urine contained bile and albumen, and was less acid and less rich in urea.

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The blood contained a large proportion of fatty matter and of cholesterine. The globules were viscous, and a little deformed. Other dogs, to which 10 milligrammes were given daily, were killed after a week. The blood was violet, and crystallised under the objective of a microscope, though the crystals were rare. The deformed globules had a raspberry appearance. All the organs showed fatty degeneration. The urine contained albumen, hæmoglobin, and biliary pigments, and was alkaline. Geese were very sensitive to the action of phosphorus, and could only bear it in very small doses. The general result was, that deposits of fat in the liver and various members were notably favoured by small doses of phosphorus, but strong doses had no such action.

Action of Biliary Acids.—In some cases, M. Ritter bound the choledochus, and, in others, injected salts of biliary acid into the veins. In every case the blood was greatly changed, showing crystals of hæmoglobin, and divided globules. It became richer in fat and cholesterine; the temperature fell. Analysis of the urine gave the same results as in the case of phosphorus. Salts of the bile acted more quickly and energetically than the phosphorus compounds. The colouring matters of the bile, on the other hand, had no toxical properties.

M. Ritter's *resumé* of results is briefly as follows:—When animals are subjected to the action of substances which greatly alter the blood globules (as compounds of antimony, arsenic, and phosphorus), crystals of hæmoglobin appear in the deformed globules; the blood is anemic, the albumen in the globules diminishes; the fibrin increases, the proportion of gas diminishes, glucose generally, but not always, increases; fatty matters and cholesterine always increase; and the variations in these correspond to the dose of the poison and the alteration in the globules. The composition of the urine varies also; the entire quantity of nitrogen and urea diminishes; the acidity diminishes and gives place to alkalinity; uric acid always increases, when the globules are greatly changed. The urine contains abnormal principles, which are most frequently colouring matters of the bile, albumen, and sometimes hæmoglobin. The compounds whose action we are considering promote formation and deposition of fat, but only when administered in certain doses.

A. B. M.

DETECTION OF BISMUTH BY THE BLOWPIPE, IN THE PRESENCE OF LEAD AND ANTIMONY.

By H. B. CORNWALL, E.M.

BISMUTH may be readily detected in the presence of antimony by the blowpipe. So likewise when with lead, by the salt of phosphorus bead and tin, even if only 0·05 per cent of teroxide of bismuth is present in otherwise pure oxide of lead. Antimony, however, yields a similar reaction with salt of phosphorus, and it has always been necessary to resort to the wet way to settle, with certainty, the presence of little bismuth with much lead and antimony.

Von Kobell's observations (*Journal fur praktische Chemie*, No. 10) on the behaviour of bismuth compounds with a mixture of equal parts of iodide of potassium and sulphur, noticed in the CHEMICAL NEWS, vol. xxiv., p. 110, suggested to the writer the use of this reaction in mixtures of the three metals, or their compounds. According to von Kobell, any bismuth compound, treated B. B. with the iodide mixture on a large coal, affords a beautiful and very characteristic red coat, at quite a distance from the assay. The writer has always obtained the reaction by employing teroxide of bismuth and iodide of potassium, entirely free from sulphur, but the sulphur adds exceedingly to the delicacy of the test.

With the view above stated, the writer made the following experiments, by heating on coal with the iodid mixture, different compounds:—

(1). Teroxide of bismuth. The red bismuth coat was beautifully formed.

(2). Protoxide of lead, free from bismuth. A copious and bright yellow coat was formed, as far from the assay as the bismuth coat.

(3). Oxide of lead, with 10 per cent teroxide of bismuth. At first a slight, but marked, red bismuth coat, quickly covered by the lead coat; which, however, had a pale orange tint, showing bismuth.

(4). Oxide of lead with 5 per cent teroxide of bismuth. A yellow coat, in no way distinguishable from that in Expt. 2. By heating a fresh portion of the oxide of lead and iodide mixture and letting the fumes condense, for a moment only, on the cold yellow coat already formed, this assumed a dark orange shade, but the reaction was far less characteristic than that obtained in Expt. 7.

(5). Oxide of lead with 1 per cent teroxide of bismuth. A coat perfectly resembling that in Expt. 2.

To increase the delicacy of the test, experiments were made in open tubes, 4 in. long, and not less than ¼ in. wide, over a Bunsen gas burner. A spirit-lamp answers as well. The iodide mixture now used contained 5 parts sulphur and 1 part iodide of potassium, by weight; and about equal volumes of this and of the metallic oxides were used. The iodide and sulphur mixture of equal parts no longer served the purpose.

(6). Oxide of lead. First, part of the sulphur sublimed and condensed above the assay, its heavy vapours also burning at the lower end of the tube. Then, copious yellow fumes passed through the tube, and an abundant sublimate condensed, which commenced about one-third of an inch above the assay, and when *quite cold* had a pure, bright yellow colour.

(7). Oxide of lead with 1 per cent teroxide of bismuth. The same phenomena as in Expt. 6, but one-third of an inch above its lower edge the yellow sublimate was replaced by a broad and distinctly red ring of the bismuth sublimate.

(8). Oxide of lead with ½ per cent teroxide of bismuth. As in Expt. 7; the bismuth sublimate, however, being rather orange-red, but so distinctly marked as to leave no doubt that even a less proportion of bismuth could have been certainly detected.

(9). 50 parts oxide of lead, 50 parts teroxide of antimony, and 1 part teroxide of bismuth. The white antimonial sublimate entirely concealed the bismuth reaction. To obviate this the mixture of the three oxides was mixed with an equal volume of sulphur and treated B. B. in a deep cavity on coal, with the blue flame, for a few moments. The resulting fused sulphides were removed to a flat coal, and treated alternately with the O. F. and R. F. until the antimonial fumes had nearly ceased, and an impure blue lead flame appeared. The residue was powdered, and a portion of it treated with iodide mixture on coal. No bismuth was detected. The other portion was treated as before in the open tube, when a distinct bismuth sublimate formed, about one-third of an inch above the lower edge of the yellow sublimate. The experiment was repeated with like success on equal parts of oxides of lead and antimony containing ½ per cent and ¼ per cent of teroxide of bismuth; and, as was to be expected, the bismuth reaction was more distinct than when the bismuth was present with lead only.

Therefore, to detect oxide of bismuth in mixtures of oxides of lead and antimony, follow the method given in Expt. 9, if there is not any decisive result obtained by the test on coal. If sulphides are under treatment, remove the excess of antimony on coal, as above.

Care must be taken not to confound with the bismuth sublimate a sublimate of iodine, which may condense on the upper part of the tube, but at a greater distance from the assay.—*American Chemist.*

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ON DYES AND DYE-STUFFS OTHER THAN ANILINE.*

By Dr. F. CRACE CALVERT, F.R.S.

(Continued from p. 142).

Annatto is the pulpy part of the seeds of the *Bixa orcellana*, which grows in South America. It is imported into this country from Mexico, Brazil, the Antilles, and especially from Cayenne, in masses covered with leaves, and varying in weight from 5 to 20 lbs. It is also imported in casks, weighing 4 or 5 cwts., as a homogeneous paste of the consistency of butter, and often having a repulsive odour of urine, which, it is stated, is added by those who store it, to keep it moist and to impart to it a richer hue.

At Cayenne, when the fruit of the bixia is ripe, it is gathered, coarsely crushed, and thrown into water, where it remains for several weeks. By this means the pulpy matter is separated from the kernel. It is next strained through a coarse cloth, and the colouring-matter gradually subsides. It is then collected, and the excess of water evaporated, until it assumes a pasty state, when it is exposed to the atmosphere in the shade until sufficiently dry to be shipped. The powder so prepared, and especially at Cayenne, is comparatively inferior, owing to the mass fermenting and producing matters which prove injurious in the drying process. The following analysis may be taken as the average composition of such qualities of annatto:—

Water	72·25
Leaves	3·85
Starch, mucilage, woody fibre	18·30
Colouring-matter..	5·60
	100·00

Some thirty years ago, a M. du Montel introduced at Cayenne some marked improvements in the manufacture of annatto. He suppressed the crushing of the seeds, separated the colouring-matter by water, and prevented the fermentation by the addition of some chemical fluid. By this means he obtained annatto in a minute state of division, and having a very beautiful red colour, which is imported into this country in the form of small tablets, which are much used for colouring cheese.

An alkaline solution of annatto gives an orange precipitate with acids, alum, or sulphate of protoxide of iron, a yellowish brown precipitate with salts of copper, and a lemon-coloured precipitate with chloride of tin.

The colouring matters of annatto have been studied by MM. Chevreul, Kerndt, and Bolley. It contains two colouring matters, one a yellow, which is soluble in water and alcohol, but insoluble in ether, and which gives a yellow colour to cloth mordanted with alum. It has received the name *orelline*, and its formula is $C_{12}H_{22}O$. According to Kerndt's statement, however, it is only a product of the decomposition of the second colouring-matter, the real colour-giving principle of annatto being *bixine*, $C_5H_6O_2$. Bolley proposes the following method to obtain bixine:—The best quality of annatto from Cayenne, after having been washed and dried, is boiled with concentrated alcohol; the alcoholic solution is evaporated to dryness, and placed to digest with ether, which dissolves a part of the residue, leaving a bright red powder, insoluble in water, but soluble in soap and alkalies, to which it imparts an orange tint, and yields a dark blue colour with sulphuric acid.

The use of annatto in print and dye works is rather limited, its chief employment being to modify the shades of other dyes, such as certain tints of yellow produced by fustic or quercitron. It is also used to give a bottom to cotton before it is dyed with safflower or cochineal. In the production of oranges in steam styles, annatto is now entirely superseded by *aurine*, a colour derived from carbolic acid. It is still often used in dyeing a low class of cotton yarns. The yarn is dipped in an alkaline solution of annatto, and then passed through a weak solution of oil of vitriol which precipitates the bixine in the fibre. It is then only necessary to wash the cotton to complete the operation. If an orange-yellow tint is required, the cotton is previously mordanted with tin.

Ilixanthine is the name given to the pale primrose yellow crystals obtained by Dr. Schunck from the leaves of the *Polygonum fagopyrum*, or common buckwheat. This body, to which he gives the formula $C_{30}H_{20}O_{20}$, is only sparingly soluble in hot and cold water, but more soluble in alcohol. Strong sulphuric acid changes its colour to a deep yellow without decomposition. It yields on a piece of calico mordanted with alumina a dark yellow colour, with tin a light yellow, and with oxide of iron various shades of yellowish brown, according to the strength of the mordant employed.

Lo-kao.—In 1851 and in 1852, public attention was drawn by several English gentlemen to samples of a green colouring matter imported from China; in 1853, Messrs. Guinon, of Lyons, imported such quantities as to enable them to dye silk for the requirements of the trade. The silks so dyed were known by the names *Vert-Venus*, *Vert-Azof*, and *Vert-Lumiere*, and were especially admired from their remaining green in artificial light. They are not, however, now produced, as the colours were unstable, and Messrs. Guinon, Mamas, and Bonnet, found that they could produce greens which maintain their colour in artificial light by first dyeing their silks in Prussian-blue, and then immersing them in an acidulated bath of picric acid. It is interesting to observe that, if indigo be substituted for Prussian-blue, the colour appears blue by artificial light.

Lo-kao is the only substance with which I am acquainted, capable, with proper reagents, of producing the seven colours of the spectrum.

M. Charvin, of Lyons, obtained lo-kao from a weed indigenous to Europe—the *Rhamnus catharticus*, and received for his discovery a gold medal, worth 6000 francs, from the Chamber of Commerce of Lyons. All these vert-lumieres are, however, now replaced by the brilliant greens obtained from aniline.

Tannin matters can be divided into two classes, those which give a blue-black precipitate with persalts of iron, such as gall-nuts, sumach, divi-divi, myrobalans, and valonia, and those which give a green colouration with persalts of iron, such as catechu, gambier, gum kino, and elder, larch, and willow barks.

The first class are characterised by containing two acids, which have received the names of tannic and gallic acids.

Tannic acid, which is the all-important compound in this class of substances, was extracted some years ago by the following simple process, devised by M. Pelouze. It consists in treating in a displacement apparatus, coarsely ground gall-nuts with ether which has been previously well shaken with water (during this process it has taken up one-tenth of its weight of the water). The ethereal solution, on being allowed to stand, separates into two layers, the upper one being nearly pure ether, and the lower one being an aqueous syrupy solution of tannin, which only requires to be evaporated in a water-bath to obtain the tannic acid as a pale yellow spongy mass, inodorous, and having a most astringent taste. As is seen by the process of extraction, it is soluble in water, but insoluble in ether. It is soluble in alcohol. It is characterised by giving a blue-black precipitate with persalts of iron, but none with protosalts, and a white precipitate with tartar emetic or salts of lead. It gives a precipitate with gelatine and the vegetable alkaloids, and turns rapidly brown or black in presence of air and caustic alkali.

Tannic acid is a glucoside, decomposed by acids into a

* The Cantor Lectures, delivered before the Society of Arts. Revised and communicated by the Author.

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peculiar sugar and gallic acid, as seen by the following formulæ:—

Tannic acid. Water. Gallic acid. Sugar.

$$C_{27}H_{22}O_{17} + 4H_2O = 3(C_7H_6O_5) + C_6H_{12}O_6$$

'*Gallic acid* presents itself under the form of fine, white, silky needles, and is soluble in water, alcohol, and ether. Under the influence of a temperature of 410° F., it unfolds itself into carbonic acid and a beautiful white crystalline compound called pyrogallic acid, which has of late years been extensively employed in photography. If the temperature be raised to a higher point than the one above mentioned, gallic acid is decomposed into carbonic acid, water, and gallhumic acid. The first decomposition may be represented by the formulæ—

Gallic acid. Carbonic acid. Pyrogallic acid.

$$C_7H_6O_4 = CO_2 + C_6H_6O_3$$

the second as—

Gallic acid. Carbonic acid. Water. Gallhumic. acid.

$$C_7H_6O_5 = CO_2 + H_2O + C_6H_4O_2$$

Gallic acid has been produced artificially by the action of potash on a di-iodosalycilic acid. When sulphuric acid is made to act on gallic acid, it transforms it into a red acid called rufigallic, which has the formula $C_7H_4O_4$. When in contact with alkalies, in presence of air, gallic acid, like pyrogallic and tannic acids, and various other organic substances, rapidly absorbs oxygen, as was shown by M. Chevreul in 1820. On this fact, Liebig, in 1838, founded an elegant method of determining the amount of oxygen in a mixture of gases. The process, is however, only approximately correct, as I proved in 1863, that under these circumstances oxide of carbon was liberated.

Gallic acid gives a purple-black precipitate, with per-salts of iron, but none with the proto-salts. It gives no precipitate with gelatine, which is a most important fact, as I shall now proceed to show.

Tannin matters, such as oak-bark, are employed for tanning leather, and the conversion of a hide into leather depends on the gradual transformation of the animal matter which it contains into gelatine. This combines with the tannic acid, producing an insoluble compound which fill the pores of the animal tissue, and thus contributes, not only to prevent its putrefaction, but to render it impermeable to water. The value, therefore, of a tannin matter depends on the amount of tannic acid it contains, the gallic acid taking no part in the tanning of the hide.

Tannin substances, such as gall-nuts, sumach, or bark, contain a ferment, which is susceptible of unfolding the glucoside tannic acid into sugar and gallic acid. It is necessary, therefore, that the tanner take great care in the management of the vats, to prevent any fermentation, especially the one called ropiness, for in such a case the vat would become useless. As it is a difficult matter often in summer to prevent this state of things, I may state that I have found that the addition of a few thousandths of carbolic acid is sufficient to prevent these chemical changes, without interfering with those which must take place in the hide.

Tannin matters, as you are aware, are much employed for producing blacks on fabrics, mordanted with per-oxide of iron. I asked myself some years since, whether it was the tannic or the gallic acid which produced the black, or if both participated in its production, and the results of my experiments clearly proved that tannic acid alone took part in its formation. This may be seen if two pieces of calico mordanted with iron are dipped, the one in a solution of tannic acid, and the other in a solution of gallic acid. Both pieces at first become dyed, but after a few days, the one dipped in tannic acid remains black, while in the one dyed with gallic acid the colour has disappeared, the gallic acid having reduced the per-oxide of iron to the state of protoxide, which, as I already remarked, does not produce a black with t acids.

As gallic acid is of no value to the dyer as a col giving principle, he must take care that his ta matters, such as sumach, are carefully stored and kept so as to avoid any gallic fermentation taking pl which would decrease the amount of tannin they cont He should also avoid holding a large stock, as the mentation above mentioned slowly proceeds in the ta matters, as is proved by the fact of sumach, for exam decreasing considerably in value, after it has been s time prepared.

(To be continued.)

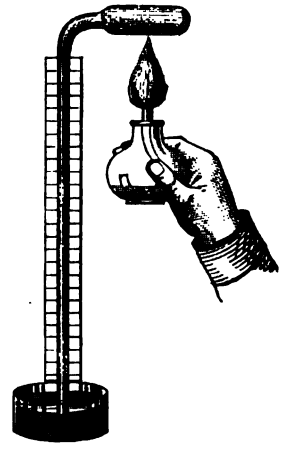
ON MEASURING TEMPERATURES BY ELECTRICITY.*

By C. WILLIAM SIEMENS, D.C.L., F.R.S., M.R.I.

THE truth revealed to us by one of the younger bran of physical science, which has been cultivated expounded nowhere more effectually than within t walls, has divested heat and electricity of their myster character, and has taught us to regard them simply "modes of motion."

Light also has been shown to be identical in its nat with heat, and the only remaining physical agen "chemical affinity," has been recognised as a fo differing only in "quality of action" from the othe According to these views, force, in whichever type action it presents itself, is as *indestructible as mat itself*, and is therefore capable of being *stored* up a *measured* with the same certainty of result. We have

FIG. 1.



unit of force or the foot-lb., and a unit of heat, or the h necessary to raise the temperature of 1 lb. of wa through 1° F., and it has been already proved that units of force are the equivalent value of one unit of he Again, the chemical force residing in 1 lb. of pure coa equal to about 14,000 heat units, or 14,000×77 10,808,000 ft.-lbs. = 4825 tons lifted 1 foot high.

Questions regarding the quantitative effects of h present themselves, however, much less frequently for consideration than questions regarding its *intens* upon which depends the nature of the phenom surrounding us at every step, both in science and ordinary life. The instrument at our command

* Read before the Royal Institution of Great Britain.

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g moderate intensities or temperatures, the hermometer, leaves little to be desired for se; but when we ascend in the scale of intensity, pproach a point when mercury boils, and from upward we are left without a reliable guide. is, that we find in scientific books on chemical statements to the effect that such or such re- s place at a *dull red* heat, such another at a a *cherry-red*, a *blood-red*, or a *white* heat— which remind one rather of the days of alchemy mical science of the present day.

e pyrometers, it is true, but these are either of nature, or little reliance can be placed on them. purpose this evening to place before you an by which I hope to fill up to some extent the p. It is the result of occasional experimental pread over several years, and it aims at the ment of a double purpose, that of measuring ratures, and of measuring with accuracy the es of *inaccessible* or *distant* places.

re entering upon the details of my subject, o place before you an instrument which fulfils, , all the conditions essentially necessary in y, and is at the same time the very first instru- vas ever proposed for measuring temperatures. the *air thermometer* by Galileo. It can be theoretical grounds, that the expansion of a gas at constant pressure is the most perfect nperature. It is, in fact, the degree of energy ical motion in an elastic fluid which determines , and which constitutes at the same time its .

hermometer consists simply of a bulb of glass tubular stem, open to the atmosphere at its If I heat the bulb (by dipping it for instance water) and put it into a holder, with the hollow ng downward into a cup of mercury, the air ulb will no longer communicate directly with here, because the mercury is interposed. If the air within the bulb, by the external applica- water, its heat motion will diminish, and its ld be reduced proportionally, if the external could enter freely to fill up the vacancy l. But inasmuch as the external air cannot duction of pressure will take place, which, the law of elasticity by Boyle, must be pro- o the reduction of volume at constant pressure. ce of pressure thus created between the bulb ternal atmosphere will be balanced by the ercury rising up into the tube, and the eleva- h the mercury attains is a true index of the to which the air in the bulb had been pre- ed. This is true with regard to all tempera- the lowest to the highest, and the instrument med a universal thermometer. If the bulb oled down to 273° C. below the zero point, it w by the law of Charles that the elastic ir would be reduced to nothing, that is to say, of the particles of air, which we call heat, ceased, and we should have reached the point zero, a point which has been theoretically also by other means.

, such an instrument would be most incon- indications would have to be corrected by for barometrical variations; the capacity of ng tube, which contains air not subjected to temperature, would have to be taken into l no reliable observations could be arrived at, ng special precautions, such as are only within experimental physicist.

r known methods of measuring ordinary and eratures were here passed in review, and the ir application pointed out. They were classi-

ters, by expansion of liquids.
ters, by the expansion of solids.

Pyrometers, by chemical decomposition of solids, comprising Wedgwood's and Deville's pyrometers.

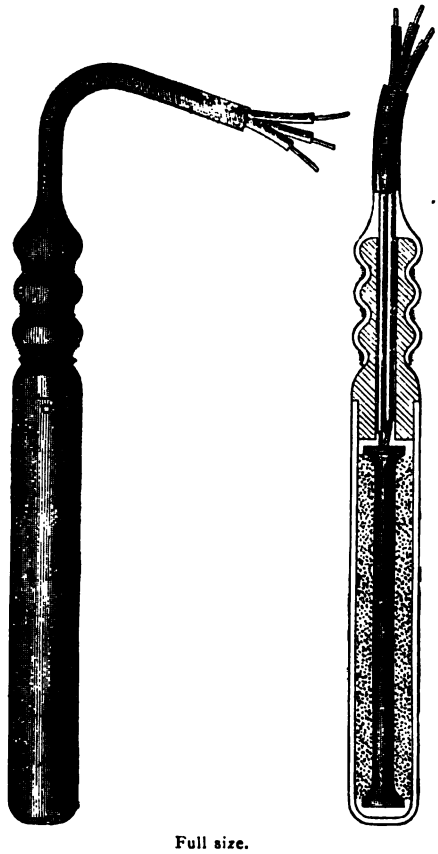
Pyrometers, by observing the melting-point of metals.

Pyrometers, by thermo-electricity.

Pyrometers, by exposing a copper or platinum ball of known heat capacity to the heat to be ascertained, and of quenching it in a measured quantity of water.]

The instrument which forms the subject matter of my discourse presents many points of analogy with the air thermometer, if we substitute "*electrical resistance in conductors*" for "*expansion of gases*"! Both these effects are functions of temperature, increasing with the temperature according to progressive laws, which in the case of the gases we call the *law* of *Charles*, and in the case

FIG. 2.



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of conductors, the law of "*increase of electrical resistance with temperature.*" The latter law, which is of recent origin, had already been partially developed by Arndsen, Swanberg, Lenz, and Werner Siemens, when my attention was directed, in 1860, towards an application of the same to the measurement of temperatures at places inaccessible to the ordinary thermometer. By means of the contrivance which I shall describe presently, I was enabled to tell, in the testing cabin of a cable-ship, the increasing temperature of the interior of the mass cable in the hold, and to prove the necessity of transhipment of the same into a vessel fitted with water-tight tanks, which have been resorted to ever since, to avoid the danger of softening the gutta-percha covering.

I have arranged an apparatus for proving to you in the first instance that the conductivity of a wire of platinum or other metal is greatly influenced by its temperature; for this purpose I direct the current of a galvanic battery

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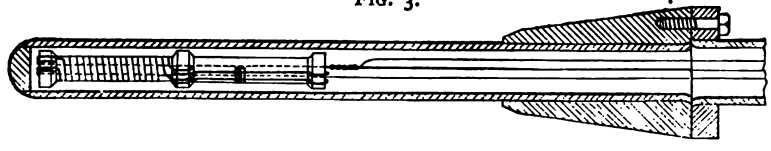
at will through two branches of equal resistance, each branch comprising a free spiral wire of platinum and one of the coils of a differential galvanometer. By throwing the powerful light of an electric lamp upon the face of the differential galvanometer, and by throwing the image by means of a mirror and lens upon the screen, the audience will see any movement of the needle to the right or the left that may take place when I complete the battery connection. The resistance of both branch circuits being the same, no deflection of the needle is observable on depressing the key, but when I pass the flame of a spirit-lamp under the one platinum coil the needle is thrown immediately over to the right, because the electrical resistance of the heated wire is increased, and consequently a larger proportion of the current is passing through the cooler circuit, exercising a preponderating influence upon the galvanic needle. When I withdraw the spirit flame from the wire, the needle rapidly returns to its zero position, but in passing it under the other spiral wire the needle immediately deflects in the opposite direction.

If, instead of using the open spirals, I were to wind thin insulated wire of any pure metal upon two small cylindrical pieces of wood, and were to enclose the tiny spirals in small silver casings, as shown (in view and in section) by Fig. 2, taking care that the extremities of the spiral wires were soldered to thicker insulated wires, leading respectively to the battery and differential galvanometer before mentioned, it follows that no deflection of the needle ensues when both the protected and equal spirals are dropped into a jar containing iced water. But if I take one of the spirals from the water, and place it, for instance, by his kind permission, into the hand of our President without disconnecting the same from its leading wires, the balance of resistance will no longer take place, and a deflection of the needle to the right actually takes place. I will now endeavour, however, to re-establish the equilibrium by adding warm water to the iced water surrounding the comparison coil near me until no deflection of the needle is observable. This result being obtained, it follows that the temperature of the water surrounding the one coil must be identical with the temperature of our President's hand, and the delicate mercury thermometer which I have placed in my solution must give me the temperature of the distant place which I intended to measure. The temperature here observed is 89·5° F., which is at this moment that of Sir Henry Holland's hands. This result is independent of the ratio in which the electrical resistance increases with temperature in the similar coils, and considering that the silver casings containing the coils are not larger than small pencil-cases, this method might be advantageously employed in physiological research. The one coil would only have to be placed within the cavity to be measured to enable the observer to read the temperature from time to time, without disturbing the patient, with the accuracy of which the mercury or spirit of wine thermometer employed is capable. But the same method is applicable for measuring the temperatures of distant or inaccessible places, such as the interior of stores or cargoes of materials liable to spontaneous combustion; of points elevated above the surface of the ground; or of great depths below for meteorological purposes; or for measuring the temperature of the sea continuously in attaching such a coil to the mariner's sounding-lead. An error would in such cases arise, however, through the uncertainty of the resistance of long leading wires, if a complete remedy of error from such a source had not suggested itself. This consists in uniting three separate insulated leading wires into a cable by which the distant coil is connected with the measuring instrument. One galvanic circuit passes from the battery through one of the leading wires, through the distant spiral, and back again through the second leading wire to the differential galvanometer and the battery, and the second passes from the same battery through the near coil, and through the third leading wire up to the distant coil without traversing the same, and back again through the second leading wire to the galvanometer and battery. Thus both galvanic circuits comprise the leading wires up to the distant coil, and all variations of resistance by temperature to which the leading wires may be subjected affect both sides of the balance equally. In constructing coils for measuring deep-sea temperatures, a large quantity of insulated copper or iron wire is wound upon a metallic tube open at both ends to admit the sea-water freely, in order to impart its temperature to the innermost layers of the insulated wire. The coil of wire is protected externally by drawing a tube of vulcanised india-rubber over it, which in its turn is bound round by a close spiral layer of copper wire, whereby the sea-water is effectually excluded from the sensitive coil. By these arrangements, the temperature of distant or otherwise inaccessible places can be accurately ascertained; but the method is limited to the range of temperature which can be obtained and measured in the comparison bath. In order to realise a pyrometer by electrical resistance, it is necessary to rely upon the absolute measurement of the electrical resistance of a coil of wire which must be made to resist intense heats without deteriorating through fusion or oxidation. Platinum is the only suitable metal for such an application, but even platinum wire deteriorates if exposed to the direct action of the flame of a furnace, and requires an external protection. The platinum wire used has, moreover, to be insulated and supported by a material which is not fused or rendered conductive at intense heats, and the disturbing influence of leading wires had in this case also to be neutralised. These various conditions are very fully realised by the arrangement represented on the diagram, Fig. 3.

Fig. 3.



Thin platinum wire is coiled upon a cylinder of hard-baked porcelain, upon the surface of which a double-threaded helical groove is formed for its reception, so as to prevent contact between the coils of wire. The porcelain cylinder is pierced twice longitudinally for the passage of two thick platinum leading wires, which are connected to the thin spiral wire at the end. In the upper portion of the porcelain cylinder the two spiral wires are formed into a longitudinal loop, and are connected crossways by means of a platinum binding-screw, which admits of being moved up or down for the purpose of adjustment of the electrical resistance at the zero of Centigrade scale. The porcelain cylinder is provided with projecting rims, which separate the spiral wire from the surrounding protecting tube of platinum, which is joined to a longer tube of wrought-iron, serving the purpose of a handle for moving the instrument. If the temperatures to be measured do not exceed a moderate white heat, or, say, 1300° C. = 2372° F., it suffices to make the lower protecting tube also of wrought-iron, to save expense. This lower portion only, up to the conical enlargement or boss of iron, is exposed to the heat to be measured. Three leading wires of insulated copper united into a light cable connect the pyrometer with the measuring instrument, which may be at a distance of some hundred yards from the same. They are connected by means of binding-screws at the end of the tube to three thick platinum wires passing down the tube to the spiral of thin platinum wire. Here two of the leading wires are united, whereas the third traverses the spiral, and joins itself likewise to one of the two former, which forms the return wire for two electrical

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circuits, the one comprising the spiral of thin wire, and the other returning immediately in front of the same, but traversing in its stead a comparison coil of constant resistance. The measuring instrument may consist of a differential galvanometer as before, if to the constant resistance a variable resistance is added. If the pyrometer coil were to be put into a vessel containing snow and water, the balance of resistance between the two battery circuits would be obtained without adding variable resistance to the coil of constant resistance, and the needle of the differential galvanometer would remain at zero when the current is established. But on exposing the pyrometer to an elevated temperature, the resistance of its platinum coil would be increased, and resistance to the same amount would have to be added to the constant resistance of the measuring instrument, in order to re-establish the electrical balance. This additional resistance would be the measure of the increase of temperature, if only the ratio in which platinum wire increases in electrical resistance with temperature is once for all established. This is a question which I shall revert to after having completed the description of the pyrometric instrument.

(To be continued).

CORRESPONDENCE.

ESTIMATION OF COPPER.

To the Editor of the Chemical News.

SIR,—I have read Mr. Hugo Tamm's articles on the "Estimation of Copper," &c., and Mr. Alfred Allen's sensible remarks thereon, and I beg leave to say that it is incredible to me that any one should bring forward at this late day a method of determining copper which requires a precipitation, when the deposition of copper on platinum by the galvanic current affords so elegant and exact a process.

I am required occasionally to determine copper in pyrites, and never dream of using any other method than that of which the following is an outline. Treat the pyrites with nitric acid to complete oxidation of the sulphur, evaporate to dryness, and ignite gently; then treat with a small amount of boiling water, and sufficient ammonia to precipitate and re-dissolve the copper. Filter the blue solution from the silica, iron oxide, &c., wash the filter, concentrate the washings if need be, make the filtrate sharply acid with sulphuric acid, and plate out the copper on the inside of a platinum dish which is made the cathode of a battery of the two small Grove's cells, the anode being a stout platinum wire hung in the solution. For a tolerably close result—generally sufficient in technical work—the solution in ammonia may be omitted, and the copper directly plated over from the solution filtered from the silica, &c. This method is steadily gaining favour here, and I am surprised that it has not already supplanted *all* other methods.

I should be glad to hear any objection raised against it by some one who has given it a fair trial. For the exact determination of very minute quantities of copper no method can approach it.—I am, &c.,

J. M. MERRICK.

Laboratory, 59, Broad Street, Boston, U.S.A.,
August 31, 1872.

PAPER FOR TELEGRAPHY.

To the Editor of the Chemical News.

SIR,—I read in the CHEMICAL NEWS, vol. xxvi., p. 60, that one of your correspondents ("T. R.") is desirous to obtain a good conductible paper, without being obliged to moisten the paper continually. I believe that I can be of some service to him, as I met with the same difficulty a couple of years ago, working in New York with the Caselli and the Lenoir autographic telegraph.

As you know, the telegram to be sent is written with an isolating ink on paper silvered by a very thin film of silver. This isolating ink was invariably composed of a gum resin solution, which had the effect of adhering to the points of the metallic comb, and thus interfering with the conductibility. I suppressed this gum ink, which I replaced by a strong solution of chromic acid, having the action of forming a chromate of silver, destroying the conductibility (being a bad conductor), and drying at once. I recommend your correspondent to employ it.

In order to obtain my receiving-paper prepared with ferrocyanide of potassium in a constant moist state, after a great many experiments I used glycerine, and obtained the very best results. I first prepare my solution of ferrocyanide of potassium, and then add the glycerine, about half of each solution. This preparation has been adopted by the Superintendent of the Western Union Telegraph, Mr. Ludovic, of New York, for the autographic telegraphs of Little. As for the points of contact, I prefer red copper to iron; the iron, being so soluble, spreads too much, and sometimes, when very fine lines are required, blots the work; copper has not the same effect.—I am, &c.,

C. WIDEMANN.

15, Rue Trévise, Paris, Sept. 22, 1872.

POWERFUL GALVANIC BATTERY.

To the Editor of the Chemical News.

SIR,—A friend has just pointed out to me that in a number of your Journal about a month since, which I did not happen to see, questions were asked in your "Notes and Queries" with respect to my batteries. As it would take up too much of your space to answer the queries fully, and it is always more satisfactory to show a thing than give a description of it, I will only say that I shall be glad, by appointment, to show anyone the construction of my batteries, and to show them a copy of the figures resulting from the experiments which I went through to ascertain the points on which I was to give explanations.—I am, &c.,

H. HIGHTON.

2, The Cedars, Putney, Sept. 19, 1872.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, September 16, 1872.

This number contains no original papers relating to chemistry; the contents are chiefly devoted to astronomy.

Annalen der Chemie und Pharmacie, No. 10, 1872.

This number contains the following original memoirs and papers:—

Mononitro-Resorcin.—P. Weselsky.—While trinitro-resorcin is easily prepared by treating resorcin with nitro-sulphuric acid, the mono-, nitro- and dinitro-resorcin are obtained with difficulty. By direct nitration, the author obtained mononitro-resorcin as a by-product of the preparation of diazo-resorcin. He describes at great length the method of purifying the mononitro-resorcin, which, in pure state, exhibits a pure lemon-yellow colour, is not bitter to the taste, is not explosive, and is not sublimable without decomposition; its fusing-point is 115°. The following bodies are also described:—Monobasic baryta salt—

$$C_6H_3NO_5\left\{\begin{matrix}Oba\\OH\end{matrix}\right.,\tfrac{1}{2}HO;$$

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hydrochlorate of mono-amido-resorcin—

$$C_6H_3NH_2\left\{\begin{matrix}OH\\OH\end{matrix}\right. + HCl + 2H_2O$$

bromnitro-resorcin fuses at 147°; formula—

$$C_6HBr_2NO_2\left\{\begin{matrix}OH\\OH\end{matrix}\right.$$

Constitution of the Phosphorus Compounds.—A. Michaelis.—The first instalment of an exhaustive monograph on this subject. Notwithstanding the high scientific value of the contents, elucidated by a series of algebraical and chemical formulæ, this paper is not suited for abstraction; it is divided into the following sections:—General introduction, treating on the phosphor compounds in general; sulphobromides of phosphorus; pyrophosphorus sulphobromide, $P_2S_2Br_4$; triethoxyl-pyrophosphor sulphobromide, $P_2S_2(OC_2H_5)_2Br$; pyrosulpho-phosphoric acid ethyl ether, $P_2S_3(OC_2H_5)_4$; diethoxyl-diethsulphyl-pyrosulpho-phosphoric acid ether—

$$P_2S_3(OC_2H_5)_2(SC_2H_5)_2;$$

orthophosphor sulphobromide, $PSBr_3$.

Formation of Sulphur Metals.—E. Priwoznik.—This memoir contains the record of some experiments made with different kinds of metals, by immersing them into a deep yellow-coloured sulphhydrate of ammonium, to which some sulphur had purposely been added; cadmium, lead, bismuth, antimony, zinc, and aluminium, are scarcely acted upon by being kept for several months in a solution of alkaline supersulphurets, care being taken that these metals are quite clean and polished previous to immersion; but, as regards copper, tin, silver, nickel, and iron, the case is different. Perfectly pure copper assumes a dark colour on being immersed in the sulphur compound of ammonium, and in a short time it is converted into monosulphuret of copper of a blue colour; but when the metal is kept immersed in the aforesaid solution for a considerable time, the blue colour changes to black, and, on analysis, the compound is found to be semi- or sub-sulphuret of copper, Cu_2S. Chemically pure silver becomes, as is generally known, very readily converted into sulphuret by the action of either sulphuretted hydrogen or alkaline sulphurets. When silver is exposed for a longer time to the action of the ammonium solution, the metal is converted into sulphuret of silver, Ag_2S. Tin also forms sulphur compounds under the above conditions, but, owing to the solubility of the sulphur compounds of tin in solutions of alkaline sulphurets, the tin is dissolved; 6·84 per cent of pure Banca tin had been dissolved in eight days. Nickel behaves like tin and iron (bright iron wire 1 m.m. thick), and is slowly and gradually coated with a thin layer of sulphuret.

Sulpho Acids of Mesitylen.—H. Rose.—This exhaustive essay is divided into the following sections:—Mesitylen-sulpho acid—

$$C_6(CH_3)_3H_2SO_3H + 2H_2O;$$

baryta, lead, and magnesia salts of this acid; brom-mesitylen-sulpho acid from mesitylen-sulpho acid; baryta, lead, potassa, soda, lime, and copper salts of this acid (the formula of the copper salt is—

$$[C_6(CH_3)_3HBrSO_3]_2Cu + 4H_2O);$$

brom-mesitylen-sulpho acid from monobrom-mesitylen and salts of this compound; nitro-mesitylen-sulpho acid from mesitylen-sulpho acid; formula of nitromesitylen-sulpho acid—

$$C_6(CH_3)_3HNO_2SO_3H + 1\tfrac{1}{2}H_2O,$$

and salts of this acid; amidomesitylen-sulpho acid—

$$C_6(CH_3)_3HNH_2SO_3H + H_2O.$$

Studies on the Combinations of the Camphor Group.—J. Kachler.—The third instalment of a lengthy monograph on this subject; this part, elucidated by a series of complex formulæ, and extensive tables exhibiting the physical properties, sp. gr., boiling-point, vapour density, and behaviour with reagents, of several of the compounds of the camphor group, is divided into the following sections:—Borneol (camphol), $C_{10}H_{18}O$; phoron and camphren, $C_9H_{14}O$; camphrenic acid, $C_9H_8O_4$.

Monochlorocrotonic Acid Obtained from Croton Chloral.—C. Sarnow.—The preparation of monochlorocrotonic acid from trichlorocrotonic acid, by the aid of water and metallic zinc-powder, is described, along with the rather tedious process of purification, at great length. In pure state, monochlorocrotonic acid is a solid crystalline substance, difficultly soluble in cold, more so in boiling-hot, water, and very readily so in alcohol and ether; fusing-point, 96°; boiling-point, 212°, yet very volatile and sublimable at 100°. Although this acid agrees in many of its properties with monochlor-tetracrylic acid (first obtained by Geuther), it (monochlorocrotonic acid) is not identical therewith. A large number of salts and ethers of this acid are described at length, and, further, the following bodies:—Monochlorocrotonid, $(C_4H_4ClO.Cl)$; monochlorocrotonamid—

$$(C_4H_4ClO.NH_2);$$

monochlorocrotonitrile, (C_4H_4ClN); monochlorobibrombutyric acid, $(C_4H_5ClBr_2O_2)$; salts of this acid.

Some of the Derivatives of Dioxybenzoic Acid.—L. Barth and C. Senhofer.—Notwithstanding the scientific merits of this essay, its contents are not well suited for any useful abstraction.

Toluol-Disulpho Acid and some of its Derivatives.—C. Senhofer.—Toluol-disulpho acid is prepared by the action of a mixture of phosphoric anhydride and sulphuric acid upon toluol, the substances being placed in a tube, which, after having been sealed, is heated to 230° for some five hours. The purification of the raw material is a rather tedious affair; the author prepared some of the free acid, in pure state, from the baryta salt of the air-dry toluol-disulpho acid—

$$C_6H_3\left\{\begin{matrix}CH_3\\SO_3\\SO_3\end{matrix}\right\}Ba + 3\tfrac{1}{2}H_2O.$$

The free acid is a solid substance, readily decomposable at 100°. In addition to several salts of this acid, the following derivatives thereof are described:—Isorcin; isoxylidinic acid.

Action of Fusing Caustic Potassa upon Benzoic Acid.—L. Barth.—This lengthy memoir treats on the products obtained by the fusion together of benzoic acid and solid caustic potassa, the operation being conducted in a silver vessel. Para-oxybenzoic acid is the main product; further, an acid, $C_{14}H_{12}O_7$; and an amorphous, yellow-coloured, resinous body, insoluble in water.

Sulpho-Para-Oxybenzoic Acid.—R. Kölle.—The preparation of this acid is described at length. The pure substance is a solid deliquescent body, soluble in alcohol, but insoluble in ether; fusing-point, below 100°. Among the salts, the potassa salt is described at length; it is crystalline; its formula is $C_7H_3K_2SO_6 + 2H_2O$.

Researches on Kynurenic Acids and Kynurin, the Product of Decomposition of these Acids.—Drs. O. Schmiedelberg and O. Schultzen.—The name of this acid is derived from κυων, "a dog," the acid being met with in dogs' urine, and obtained from it by a rather difficult process of operation. Pure kyanurenic acid is a solid, crystalline, needle-shaped body, insoluble in water, and also in water acidulated with either hydrochloric or nitric acids, but somewhat soluble in these acids when concentrated, and also pretty soluble in boiling alcohol; the acid fuses at 266°, but is then somewhat decomposed, much gas being evolved; with baryta, kyanurenic acid forms a rather difficultly soluble salt. The formula of the free acid is—

$$C_{20}H_{14}N_2O_6 + 2HO;$$

that of the baryta salt is $C_{20}H_{14}N_2O_6Ba + 3H_2O$. Kynurin is the substance which is obtained by fusing the kynurenic acid at 265° on an oil-bath; much carbonic acid is given off, and, after purifying, a solid, crystalline, neutral body is obtained, slightly soluble in alcohol, and fusing at 201°; formula, $C_{18}H_{14}N_2O_2$.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, June 16, 1872.

Studies on Dynamometers.—C. Mène.—The continuation of an essay on this subject, illustrated with woodcuts.

Preparation of Nitrite of Amylen for Pharmaceutical Use.—C. Mène.—From the crude alcohol of commerce, this substance may be prepared in the following manner:—The crude alcohol, which is readily obtained in France, is first washed with a concentrated aqueous solution of common salt, and then with a large quantity of water, after which the remainder is submitted to distillation in a retort, to which a thermometer is fitted; that which distils over below 125° is set aside as unsuitable, but the distillate from 125° to 140° is kept and rectified at 132°. The amylic alcohol thus obtained is poured into another retort, fitted with a safety-tube; some clean copper wire having been put into the retort, a mixture, of about one-tenth each of the bulk of the alcohol, of sulphuric and nitric acids is then added. The temperature is gently raised to 65°; nitric acid is again added to the liquid in the retort, and the operation of distillation re-commenced until red vapours appear; the product is then washed with caustic soda solution and re-distilled over carbonate of potassa. The portion which distils over between 95° and 100° is nitrite of amylen, sufficiently pure for pharmaceutical use. Amylic alcohol may be obtained in this country from manufacturing chemists, thus saving the trouble of separating it from crude alcohol.

La Revue Scientifique de la France et de l'Etranger, September 7, 1872.

This number contains no original papers relating to chemistry or collateral subjects.

September 21, 1872.

The contents of this number are devoted to the record of the proceedings of the Bordeaux meeting of the French Association for the Advancement of Sciences. The President of the Chemical Section is Professor Balard; Honorary Presidents, Drs. Stas and Von Baumhauer; Vice-President, Dr. Wurtz; Secretary, M. Lecoq de Boisbaudran. From the condensed report of the proceedings we glean the following:—Prof. Berthelot gave a concise, yet extensive *resumé* of his researches on the condition of bodies when in solution, pointing out the important bearing of the results obtained by him as regards its application to the study of wines, mineral waters, blood, milk, urine, &c., and molecular mechanics. M. Jungfleisch, after briefly alluding to Pasteur's researches on the synthesis of racemic acid, and also to those of Dessaigne, Perkins, and Duppa, stated that all substances derived from tartaric acid by elimination of water regenerate, by absorption of that fluid, tartaric acid, which turns the plane of polarisation to the right, but, as soon as the tartaric acid is submitted, in the presence of water, to a high temperature, this does not further obtain; at 175°, a considerable portion of racemic acid is formed, while the mother-liquor from that acid contains a quantity of inactive (optically) tartaric acid; these facts are of general application. Anhydrous camphoric acid regenerates the acid from which it was obtained; when, however, camphoric acid is heated in the presence of water, other products, differing from anhydrous camphoric acid, are formed. Dr. Schützenberger gave a brief account of his researches on platinum compounds; by causing oxide of carbon to react upon bichloride of platinum, three different products are obtained, according to the conditions under which the operation is conducted, viz., $COPtCl_2$, $C_2O_3PtCl_2$, and a compound of these two. Perchloride of phosphorus attacks platinum at 250°, and gives an analogous compound, $PhCl_5PtCl_2$, which crystallises, and yields in its turn, with $PhCl_5$, another canary-coloured product, $(PhCl_5)_2PtCl_2$; in contact with water, the product $PhCl_5PtCl_2$ is converted into a hydrate—

$$Ph(OH)_6PtCl_2,$$

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a veritable acid, which yields, with lead, a compound—

$$Ph(OPb)_2PtCl_2 + PbO,$$

which is a detonating salt. With alcohol, $PhCl_2PtCl_2$ yields a crystalline compound, fusing at 83°, and yielding chloride of ethyl when heated to 180°, leaving a compound, $Ph(C_2H_5O)_2PtCl_2$; by further heating, this compound is converted into chlorhydric acid, ethyline, polyphosphoric acid, and platinum. The compounds of ammonia and $Ph(C_2H_5O)_2PtCl$, and derivatives therefrom, are next alluded to, and, lastly, the series of the compound $(PhCl_2)_2PtCl_2$. M. Henninger gave a brief account of his (and Vogt's) researches on the synthesis of orcin. Filhol discussed the condition in which sulphur is met with in the mineral waters of the Pyrenees. In the Section for Civil and Military Engineering, M. E. Lemoine read a lengthy paper on the repartition of the pressure in a network of gas-mains and on the best means to regulate that pressure. Among the papers read in the Mathematical Section, we notice a memoir by M. Saint-Loup, on the elastic force of vapours in relation to temperature. M. Hureau de Villeneuve explained the construction and management of a new kind of steam-boiler, which is heated by petroleum, and appears to possess great advantages, especially as regards prevention of loss of heat. In the Zoological Section, important and practically available communications are made on ostreiculture, especially in reference to the labours of MM. Michelet and Austchysky at the Bay of Arcachon, where oysters are now cultivated on a large scale. To this number is added the list of the names of all the members of the Association.

Polytechnisches Journal von Dr. E. M. Dingler, second number for August, 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral subjects:—

Application of the Water Air-Pump to Evaporation, Distillation, Filtration, &c., in Vacuum.—F. A. Wolff and Sons.—This paper, illustrated by engravings, contains the record of a series of technical experiments made with a contrivance somewhat like Bunsen's air-pump (described by Winkler in Dingler's *Polytech. Journ.*, vol. cxcv., p. 34, 1870). It appears that many of the industrial operations may be more rapidly and advantageously conducted by the aid of a vacuum.

Basic Carbonate of Lime in Hydraulic Cements.—A. R. Schulatschenko.—The contents of this exhaustive monograph, elucidated by a large number of analyses of limestones and cements, may be *resumed* as follows:—The formation of basic carbonate of lime as a consequence of the incomplete burning of the limestone is doubtful; the incomplete burning of aluminous limestones *(thonhaltige kalksteine)* rarely yields good results. Considering the excellent quality of the Roché cement, the author thinks that the Wolchowo (Russia) aluminous limestone will yield a cement of better quality.

Studies for Establishing a Scientifically-Arranged Tanning Method.—A. Reimer.—The continuation of an exhaustive essay, this portion being divided into the following sections:—Skin (hide) with alum and common salt; mixture of equal parts of the two last-named salts; sulphate of alumina only; acetate of alumina.

Test for the Adulteration of Beer with Caramel.—Dr. R. Schuster.—The author states that when beer is mixed with a solution of tannic acid, and thoroughly shaken, it is discoloured when malt only has been used, but, when caramel has been added, the colour remains unaltered.

Estimation of Acetic Acid in Wine.—E. Kissel.—The wine is first neutralised with baryta; next, the alcohol is distilled off; and then phosphoric acid is added, and the liquid re-distilled; the distillate contains the acetic acid.

Bayerisches Industrie und Gewerbe-Blatt, August, 1872.

Aluminium-Plating.—Dr. C. Winkler.—This memoir contains a discussion on the methods and practicability of coating other metals with aluminium. From the author's researches on this subject, it appears that neither galvanoplastically, nor also by the well-known method of plating, the object in view can be obtained.

Methods of Detecting and Quantitatively Estimating Paraffin in Stearine Candles.—M. Hock.—After reviewing the various methods employed for this purpose, the author states that it is best to saponify the stearine (really stearic acid) with moderately strong caustic potassa, to convert the soap thus obtained into a soda-soap, by means of chloride of sodium, and to treat the soda-soap on a filter, first with cold water, and next with some dilute alcohol; the soap is dissolved, and the paraffin set free; the filter is then dried at a temperature of about 35°, after which the paraffin is dissolved in ether, and this solution evaporated, and the residue weighed. This method has been tried by the author with mixtures of known quantities of stearine and paraffin, and found to answer well.

French Putty.—Ruban.—7 pounds of linseed oil are boiled with 4 pounds of brown umber for about two hours; 62 grms. of chips of wax are then added to the oil. After having been removed from the fire, a mixture of 5½ pounds of chalk and 11 pounds of dry white-lead is added to the oil. This putty is stated to be very durable, and to adhere strongly to wood which has not been painted.

Very Durable Crucibles for Smelting Steel and other Metals.—Dr. G. Feichtinger.—These crucibles are made with the following mixture:—Ground-up and lixiviated porcelain mass, 10 parts; graphite, 10 parts; asbestos (cut up into threads of some 3 m.m. length), 15 parts; powdered quartz, 3 parts; fire-clay, 22 parts.

Archives Neerlandaises des Sciences Exactes et Naturelles, Vol. vii., No. 2, 1872.

The following original papers and memoirs relating to chemistry and collateral subjects are published in this number:—

Influence which the Temperature Exerts upon the Rotatory Power of Tartaric Acid and Tartrates.—F. W. Krecke.—This lengthy essay, illustrated by woodcuts, is divided into the following sections:—Introduction, containing a concise review of the labours of Biot and others, and of the general laws of rotation of organic bodies; method of observation; influence of temperature upon the specific rotatory power of tartaric acid; influence of the temperature upon the specific rotatory power of the tartrates, viz., of potassa, soda, ammonia, sal-seignette, potassio-tartrate of antimony; conclusions. The paper contains a series of tables exhibiting results of experiments.

Determination of the Temperatures in the Experiments of M. V. Regnault on the Elastic Force of Aqueous Vapour and Steam.—J. Bosscha, jun.—This essay, elucidated by a series of tables exhibiting results of experiments, is written more particularly to show certain errors in Regnault's work.

Meteorite of Knyahinya, in the Comitat of Unghvär (Hungary).—E. H. von Baumhauer.—This exhaustive memoir contains, in the first place, a detailed account of the phenomena attending the fall of this meteorite on June 9th, 1866, as witnessed by several persons whose evidence was taken in writing by the late Chevalier W. von Haidinger. The second portion is devoted to the chemical analysis and method of investigation applied. The composition of this stone is, in 100 parts:—Nickeliferous iron, 5·0; sulphuret of iron, 2·2; chrome iron, 0·8; olivine, 39·9; insoluble bisilicate, 52·1.

Meteorite de l'Aigle, Departément de l'Orne, France.—E. H. von Baumhauer.—This meteorite fell on April 26th, 1803. A record is given of the analysis of this stone, which was found to contain, in 100 parts—Nickeliferous iron, 8·0; sulphuret of iron, 1·8; chrome iron, 0·6; sulphate of lime, traces; olivine, 45·3; bisilicate, 44·3.

Although not strictly relating to chemistry, we quote the titles o the following essays:—

Poisoned Arrows of Africa.—A. W. M. van Hasselt.—The results of physiologico-toxicological experiments made with, and the botanical origin of, the arrow-poison used in Africa.

General Report on the Observations of the Total Eclipse of the Sun of December 12th, 1871, drawn up from the Reports of various observers in the Island of Java by Dr. Oudemans, Chief Engineer of the Geographic Bureau at Batavia.

Artificial Production of some of the Principal Formations of Organic Calcareous Origin.—P. Harting.—This paper, illustrated by woodcuts, records the author's ingenious investigations, by which he has artificially produced calcareous forms exactly like those made by the lower orders of animal life.

Vol. vii., No. 3, 1872.

This number contains, in addition to several original papers and memoirs relating to mathematics and natural history, the following original papers relating to chemistry:—

The Chemical Process (Chimisme) of Respiration Considered as a Phenomenon of Dissociation.—F. C. Donders.—Reserved for translation.

Mannite and Nitro-Mannite Considered in their Action upon Polarised Light.—F. W. Krecke.—This essay is elucidated by a series of tables. The author's conclusions are—(1) Mannite which is optically-inactive is converted, by the action of nitro-sulphuric acids, into optically-active nitro-mannite; (2) optically-active nitro-mannite is converted again into optically-inactive mannite by sulphuret of ammonium; (3) optically-active dextrose is converted, under the influence of sodium amalgam or of platinised magnesium *(magnesium platine)*, into optically-inactive mannite; (4) the optically-inactive mannite thus obtained is converted by nitro-sulphuric acids into optically-active nitro-mannite; (5) slight molecular changes of bodies are sufficient to convert them from optically-active into optically-inactive substances and *vice versâ*.

Slow Combustion.—P. J. van Kerckhoff.—Reserved for translation.

Primary Normal Hexylic Alcohol Contained in the Essence of the Heracleum Giganteum.—A. P. N. Franchimont and Th. Zincke.—An abstract of this extensive memoir was published in another periodical, and quoted in the CHEMICAL NEWS (vol. xxv. p. 57).

Pharmaceutische Zeitschrift für Russland, No. 10, 1872.

The only original paper published in this number is the continuation and conclusion of the memoir—

Relation of Modern Chemistry to Metallurgy.—Dr. C. Winkler

No. 11, 1872.

This number contains no original papers relating to chemistry, but we notice the following memoir:—

Description of some Pharmacognostically Important Objects in Use in Central Asia.—R. Palm.—The author gives an accoun of the following substances:—Schörum-Dorü is a kind of sea-weed obtained from the salt-lakes of Thibet; the chemical investigation o this substance proved it to contain about 1 per cent of iodine, combined with bases. When boiled with water, this sea-weed (of which a lengthy botanico-pharmacognostical description is given) yields a jelly no

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dissimilar to that obtainable by the same treatment from Irish moss *(Lichen Carraghen)*. The ash contains sodium, magnesium, alumina, calcium, potassium, oxide of iron, chlorine, iodine, sulphuric acid, silica, phosphoric acid, and carbonic acid; according to the author, no plant has yet been found to contain so large a quantity of iodine as this sea-weed. Sirauwant is a kind of tubercle, which contains 47·57 per cent of starch, 2·88 per cent of salts (ash), and also a peculiar principle, which somewhat resembles emetin, but of which, in consequence of insufficient material, no further investigation could be made. Bucharian nutgalls, locally known as Busgunsch, contain 43·10 per cent of tannic acid, 3·03 per cent of a green waxy matter, and 16·0 per cent of cellulose.

Chemisches Centralblatt, No. 35, 1872.

This number contains the following original communications:—

Precipitate Produced in Beer by the Addition of a Solution of Carbonate of Potassa.—A. Metz.—It appears that a concentrated solution of the salt alluded to produces in beer a slight, but distinct, crystalline precipitate (10 grms. of the salt to 1 litre of beer), which consists of hydrated phosphate of potassa and magnesia—

$$KO.2MgO.PO_5+12HO.$$

Preparation of Artificial Fuel from Small Coal and Small (Pulverulent) Anthracite.—F. Loiseau.—By the addition of about 5 per cent of clay to the coaly matter, the author forms it, by strong pressure, into the shape of large-sized bricks, which are next placed in a solution of resin in benzin (benzoline), and then dried; by this process, the artificial fuel is rendered impervious to water, and more readily combustible.

NOTES AND QUERIES.

Gum Copal.—(Reply to C. T. Kingzett).—This resin is not soluble in alcohol, which is the ordinary solvent of resins, but, after having been first softened by pure ether, which renders copal gelatinous, the resin is soluble in alcohol; chloroform dissolves copal readily, but the best solvent is the empyreumatic oil obtained by the dry distillation of caoutchouc, and also the empyreumatic oil obtained when copal is heated above its melting-point, which is between 180° and 340°. Strong liquid ammonia renders copal gelatinous, and, when heated with a concentrated aqueous solution of caustic potassa, it is dissolved. It should be remembered that, under the name of copal, resins of different origin are imported from different countries, and the properties of these differ greatly. By exposure to air, after having been first pulverised, copal absorbs oxygen, and becomes more readily soluble in the solvents mentioned, as well as in oils of turpentine and rosemary.

PATENTS.

Communicated by Messrs. Vaughan and Son, Patent Agents, 54, Chancery Lane, London, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

1421. J. Robey, Manchester, "A new or improved filtering medium suitable also as a disinfectant and deodoriser."—Petition recorded May 10, 1872.

2115. J. G. Tongue, Southampton Buildings, Chancery Lane, "Improvements in the production of fertilising materials or manures, and in the means and apparatus employed in the manufacture of the same, partly applicable to other purposes."—A communication from H. A. Hogel, New York, and H. B. Bigelow, New Haven, Conn., U.S.A.—Petition recorded July 13, 1872.

2337. T. Richardson, J. W. Richardson, and A. Spencer, West Hartlepool, Durham, "Improvements in the manufacture of iron and steel, and of revolving puddling furnaces or convertors, and apparatus to be employed therein."—Petition recorded August 6, 1872.

2396. R. Hadfield, Sheffield, Yorks, "An improved process for making steel wheels, and for combining steel or wrought-iron with cast-iron or other similar metal."—Petition recorded August 12, 1872.

2429. T. J. Denne and A. Heutschel, Mile End, Middlesex, "Improved combinations of ingredients for treating, preparing, stiffening, and thickening raw, felted, spun, and woven fibres and fabrics, also for use in dyeing and printing such fabrics and fibres."—Petition recorded August 15, 1872.

2506. E. A. Cooke, Viewville House, Midlothian, N.B., "Improvements in treating animal charcoal."

2510. W. Vincent, Arborfield, Berks, "Improvements in apparatus for manufacturing gas."—Petitions recorded August 23, 1872.

2528. J. F. Parker and A. Wade, Birmingham, "Improvements in the manufacture from coal and petroleum of hydrocarbon gas, or gas for illuminating and heating."

2538. H. Y. D. Scott, C.B., Ealing, Middlesex, "Improvements in the treatment of sewage, and in the preparation of manures therefrom."—Petitions recorded August 26, 1872.

2542. W. W. Box, Crayford, Kent, "Improvements in apparatus used in the manufacture of gas."—Petition recorded August 27, 1872.

2569. B. W. Gerland, Ph.D., Macclesfield, Cheshire, and E. Johnson, Dartmouth Park, near Sydenham, Kent, "Improvements in the manufacture of sanitary charcoal and the application thereof to the treatment of sewage."

2573. J. Hargreaves and T. Robinson, Widnes, Lancashire, "Improvements in the manufacture of hydrochloric acid, and in apparatus employed therein."—Petitions recorded August 29, 1872.

2617. F. C. Danvers, Ealing, Middlesex, "Improvements in the manufacture of artificial fuel."

2619. F. R. H. Protheroe, Lydney, Gloucestershire, "Improvements in the manufacture of paper."—Petitions recorded September 3, 1872.

NOTICES TO PROCEED.

1293. C. Duff, Wandsworth Road, Surrey, "Improvements in the treatment of fibrous substances to be used in the manufacture of pulp for paper, and for conversion into spun and textile fabrics."—Petition recorded April 30, 1872.

1307. L. Bradley, Rotterdam, Holland, "Improvements in the manufacture of cement."—Petition recorded May 1, 1872.

1375. C. Viel, Compton Street, Brunswick Square, Middlesex, "A new washing fluid for obliterating marks or stains in white linen."—Petition recorded May 6, 1872.

1415. B. French, Rochester, New York, U.S.A., "Improvements in lubricating compounds."—Petition recorded May 10, 1872.

1432. J. Sutherland, Glasgow, N.B., "Improvements in furnaces for puddling and re-heating iron."—Petition recorded May 11, 1872.

1468. J. Spratt, Camberwell, Surrey, "A new or improved food for cats."—Petition recorded May 14, 1872.

2426. D. Joy, Saltburn-by-the-Sea, Yorkshire, "Improvements in the means and apparatus for purifying iron, and for removing the slag and other impurities from blast and other furnaces."—Petition recorded August 14, 1872.

2572. W. R. Lake, Southampton Buildings, London, "Improved compounds, chiefly designed for coating ships' bottoms."—A communication from J. H. Bloodgood, New York, U.S.A.—Petition recorded August 29, 1872.

PATENTS SEALED.

766. S. J. Beaman and J. Onions, Wednesbury, Staffordshire, "An improved puddling furnace."—Dated March 14, 1872.

794. J. Russell, Bonnyfield, and W. R. Hutton, Stirling, N.B., "Improvements in obtaining zinc."—Dated March 15, 1872.

826. W. Garey, Aberdeen, N.B., "Improvements in preparing paper for photographic purposes.

836. D. Nicoll, London, "Improvements in compounds for, and in the treatment of, fabrics to render the same waterproof and uninflammable."—Dated March 19, 1872.

971. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in liqueurs or cordials and other beverages, and in apparatus to be employed in their manufacture."—A communication from F. A. Joannon, Paris, France.—Dated April 3, 1872.

1051. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the treatment of animal and vegetable substances."—A communication from W. Adamson, Philadelphia, Penn., U.S.A.—Dated April 9, 1872.

1376. D. G. Fitzgerald, North Brixton, Surrey, and B. C. Molloy, Temple, Middlesex, "Improvements in treating compound substances by the agency of electricity, and thereby decomposing them or resolving them into their components, and in apparatus employed therein." Dated May 6, 1872.

1516. J. Baird, Glasgow, N.B., "Improvements in treating oils for lubricating and other purposes."—Dated May 18, 1872.

2153. W. Paterson, W. A. Sanderson, R. Sandersoll, and J. Sanderson, Galashiels, "Improvements in the treatment of wool in process of manufacture and in the preparation of materials therefor." Dated July 18, 1872.

PATENTS GRANTED IN BRITISH COLONIES AND DEPENDENCIES.

NEW SOUTH WALES.

286. F. Sacc, M.D., Neufchatel, Switzerland, "Improvements in the preservation of fresh meat and vegetables, and in the preparation of extract of meat."—Dated May 10, 1872.

288. A. Noble, Hamburg, "Improvements in the manufacture and use of an explosive compound."

289. R. Bright, Melbourne, Victoria, "Improvements in the construction of furnaces for smelting ores, and for an improved method of smelting antimony and other ores."—Dated May 30, 1872.

VICTORIA.

Application for Patent.

1638. L. Hesse, Melbourne, "Improvements in the manufacture of albumen from blood."—Dated May 31, 1872.

Patents Granted.

1589. A. Morgan, Footscray, "Improvements in the manufacture of cement."—Dated December 11, 1871.

1591. L. Y. Ball, East Melbourne, "Improvements in the curing of meat."—Dated December 20, 1871.

1628. J. Watteau, Antwerp, Belgium, "An improved depilatory composition for hides and skins.—Dated May 6, 1872.

TO CORRESPONDENTS.

H. Hargreaves.—Write to the office, Rue de Buci 12, Paris.

J. F.—Slatter's "Analytical Chemistry," or Noad's "Chemical Analysis."

St. Thomas.—Dr. Duflos's work is not published in English.

J. F. Armstrong.—You can obtain American and Saxony Patents at the Patent Office, Southampton Buildings, Chancery Lane.

Birkbeck Institution.—Since the publication of our Student's Number, it has been decided to commence the Chemistry Classes on Tuesday evenings at 7.30 p.m., instead of at 8 p.m.

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THE CHEMICAL NEWS.

VOL. XXVI. No. 671.

ON THE

OCCURRENCE IN RECENT PINE TIMBER OF FICHTELITE, A HYDROCARBON HITHERTO ONLY KNOWN IN A FOSSIL STATE.

By J. W. MALLET, Ph.D., M.D.,
Professor of Pure and Applied Chemistry, University of Virginia.

SOME nearly colourless crystalline crusts found in clefts between the annual rings of growth of a log of long-leafed pine (*Pinus Australis*) in Alabama were found to dissolve in boiling alcohol (more easily in ether), and, on cooling, to crystallise in monoclinic forms with greater distinctness. A specimen was exhibited of this material purified by two or three re-crystallisations; it had been found to agree perfectly in physical and chemical properties with the fichtelite of Bromeis and Clark, and on analysis yielded—

Carbon	87·82
Hydrogen	11·91
	99·73

agreeing with the formula $x(C_3H_8)$. The fusing-point was found = 45° C.

ADJUSTMENT OF VOLUMETRIC TEST-SOLUTIONS.

By F. MAXWELL LYTE, F.C.S.

I BEG to suggest a mode of adjusting the strength of volumetric test-solutions, which offers at least the advantage of dispensing with tedious measurements, and offers a means of a more rapid adjustment where large bulks of liquid are to be dealt with. I cannot do better than simply illustrate my plan, without further explanation, by a practical example.

Let us suppose a deci-normal test-solution of oxalic acid to have been made, and, taking this as a basis, that it is desired to manufacture a solution of soda exactly to correspond with the deci-normal acid. The usual method employed is to make a soda solution more concentrated than requisite, to try how much of this liquid corresponds to a measured volume of the deci-normal acid, and to calculate thence the percentage volumes of soda solution and water which have to be mixed to bring the alkaline solution to deci-normal strength. The adjustment is then obliged to be made by actual, and for large quantities tedious, measurements.

My mode of proceeding is as follows:—Suppose a large jar of soda solution is to be made. I make, first of all, say, half the jar full of solution, which I guess will be nearly double the required strength, over or under the mark, it matters but little which, and I titrate to find out how much of the solution is equal to a given volume of deci-normal acid. I now add a measured quantity, say 200, 500, or 1000 c.c. of water, as the case may be, and I titrate again. This time I shall have brought my alkaline solution somewhat nearer to the deci-normal standard, and, without knowing the bulk of the original alkaline solution, I am able to calculate the percentage effect of my addition of water, and from this, by a simple proportion, I can easily calculate how much water I ought to have added in order to render the alkaline solution strictly deci-normal.

A jar of about 45 to 50 litres capacity contained soda solution to be adjusted; 88 c.c. of this solution were found to correspond to 100 c.c. of deci-normal acid. 500 c.c. of water were added, and, on titration, it was found that 93 c.c. now corresponded to 100 c.c. of acid. The liquid, then, originally required to be lowered in strength 12 per cent, and the addition of the 500 c.c. of water lowered it 5 per cent; if, then, instead of 500 c.c., we had added 1200 c.c., we should have reduced the solution to deci-normal strength; therefore, to effect this, all we have to do now is to add 700 c.c. more of water, and the liquid is adjusted thus without further measurement or manipulation. Of course, if the alkaline solution had been too weak originally, instead of being too strong, the water added might have been substituted by a strong solution of soda, and the adjustment proceeded with on the same basis.

Paris, Sept. 19, 1872.

ON THE

PRESENCE OF GOLD IN SEA-WATER.

By E SONSTADT.

I HAVE used three entirely different methods for the detection of gold in sea-water, but all the methods were applied to the water itself, not to the residue left on evaporation. The experiments have been made upon specimens collected at different times from different parts of Ramsey Bay, Isle of Man, and the results obtained from the different specimens have been in entire accordance. The proportion of gold contained in sea-water (certainly less than one grain in the ton) is much too small to admit of separation, or even detection, by the usual tests applied in the usual manner. Besides the difficulty of detection arising from the small proportion of gold present, there is another difficulty of a graver kind, due to a continuous re-solution of the gold after it has been separated in the metallic state. This re-solution is owing to the separation of iodine under the influence of reducing agents upon the iodate of calcium, which, in a paper published in the CHEMICAL NEWS, I have shown to exist in sea-water. Even if the reducing agent is added in very large excess, oxidation takes place so rapidly under the continuous re-forming power of iodate of calcium, that, sooner or later, according to the excess of reducing agent used, the stage arrives at which iodine is set free, and the suspended gold is re-dissolved.

I. The first method I shall describe of detecting gold in sea-water may be practised upon so small a quantity of water as 150 or 200 c.c. Two or three decigrammes of pure ferrous sulphate are dissolved in the water, which is acidulated by two or three drops of hydrochloric acid. The solution is heated in a *chemically clean* and well-glazed porcelain dish, over a small flame, so managed that the flame may touch the under part of the dish without causing ebullition. Under these circumstances a lustrous film of ferric oxide forms in the dish, commencing from the portion directly heated by the flame. The heat is continued, without boiling, until the sea-water is evaporated to about half, or so long as the film increases in extent and in lustre. The liquid is then poured off, the strongly adherent film is rinsed with a little water, and then about 50 c.c. of strong chlorine water is allowed to stand in the dish for an hour or two, after which it is slowly evaporated down (over the film) to a few drops, a drop of dilute hydrochloric acid being added towards the end of the evaporation. The liquid, which should be nearly colourless, is then poured into a test-glass containing a few drops of solution of stannous chloride, when, after a few minutes, the liquid takes a bluish or purplish tint, which may be exactly matched by a drop or

* Read before the British Association, Brighton Meeting, Section B.

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two of a suitably diluted solution of gold added to a corresponding portion of tin-salt in another glass. The reaction may, of course, be made more striking by taking for the experiment a larger quantity of sea-water, although the reaction obtainable from the quantity indicated is quite definite. I have repeated this experiment many times, upon different specimens of sea-water, and always with the same result when a *film* was obtained on evaporation. But the formation of this film depends upon the iron being in a particular degree of oxidation, and I have sometimes failed to obtain it. The best way is, after adding the ferrous sulphate and hydrochloric acid to the sea-water, to leave it exposed to the air for a few hours, or over night, before heating the liquid to obtain the film. Corresponding experiments were made, in the same vessels and with the same reagents, upon simple water, and upon water containing chloride of sodium and alkali sulphates in solution, but the films obtained, when treated as described, never gave the slightest colouration with solution of stannous chloride. The chlorine solution off the sea-water films may be dried up in a porcelain crucible with precipitated lead, and gold beads obtained by cupellation, after fusing the lead into a button with borax; but for this experiment at least half a litre of sea-water should be taken, and even then the bead obtained is not ponderable.

II. From half a litre to a litre of sea-water should be taken for the experiment now to be described. As much solution of pure chloride of barium is added to the water as will give about a grain of precipitate. A day or two should be allowed for the precipitate to settle. The precipitate is collected, dried, mixed with borax and lead, and the button of lead obtained before the blowpipe on charcoal is cupelled. The bead obtained is yellowish white, of the same colour as an alloy of 60 parts gold to 40 of silver, or thereabouts. For confirmation of the presence of gold the bead may be dissolved, in a very small test-tube, in a few drops of aqua regia, which is then evaporated, at a gentle heat, nearly to dryness. A few drops of pure hydrochloric acid are added, and the solution again evaporated, to destroy the excess of nitric acid. The solution is evaporated very nearly, but not quite, to dryness, a few drops of water are added, and the mixture warmed, and when the chloride of silver is settled a drop of solution of stannous chloride is allowed to fall down the side of the tube into the liquid, when the characteristic gold reaction is obtained. This experiment is delicate, and requires some care. For the laboratory method I. is much the easier and quicker of the two; but it is conceivable that method II. might be practically applied to the exploitation of the gold in sea-water, which might be received at high water in large tanks, and emptied at low water, the chloride of barium solution being meanwhile used, and the precipitate left in the tank taken out from time to time.*

III. The method that I give last was that whereby I first obtained evidence of the presence of gold in sea-water; but this method is open to objection, as being more troublesome than the preceding methods. To at least a litre of sea-water, contained in a stoppered bottle, a few grammes of ferrous sulphate are added, and after two or three days some solution of stannous chloride, followed by solution of mercuric chloride, taking care that the latter is added in such proportion that the water is still capable of separating mercury from more solution of mercuric chloride. Neither the precipitates caused by ferrous sulphate nor by stannous chloride, in sea-water, carry down with them more than a small fraction of the gold present in sea-water; but when the mercuric chloride is added to the water already containing stannous chloride, mercury is precipitated in the liquid, and, as it subsides, carries down with it both gold and silver as an amalgam. The ferrous sulphate may be dispensed with, but then a larger proportion of stannous chloride must be used, and this oxidises so rapidly in sea-water that there is danger of re-solution of its precipitated gold by iodine, as mentioned at the beginning of this paper. The precipitate, if tin and mercury salts only have been used, may be ignited, and assayed in the usual way, and the bead obtained treated as described under II. The assay is, however, troublesome, owing to the large proportion of tin oxide to be treated. But if the precipitate contains iron oxide, the usual method of assay will fail, because during the process of smelting, iron oxide is reduced to the metallic state, even at a low red heat; and the spongy iron locks up the gold and silver away from the lead. Hence, in assaying substances containing much iron oxides, it is necessary, as far as possible, to prevent reduction of the iron by using only borax as the flux, and that in proportion large enough to hold the iron oxide in complete solution. The oxidating and not the reducing flame of the blowpipe must be used upon the assay.*

The reagents used in all these experiments were not only severely tested separately as to freedom from the precious metals, but in each set of experiments on the sea-water, entirely correspondent experiments were made upon rain-water, always with negative results.

I have referred to the solvent action of very dilute solutions of iodine upon gold. The following experiment illustrates this action. A little precipitated gold was added to strong hydriodic acid, slightly coloured by iodine but otherwise quite pure. The acid quickly became opaque. A drop or two of the solution added to a rather strong solution of stannous chloride in a test-glass immediately caused precipitation of purple-of-cassius, the supernatant liquid being colourless, and remaining so on addition of more tin solution. After a few days' exposure, the liquid smelt of iodine; and then addition of more tin salt caused instant separation of purple precipitate;—proving that the iodine liberated had dissolved some of the precipitated gold. After another day or two of exposure, gold was again in solution, and was precipitated by further addition of tin salt, and this was repeated several times; and evidently the re-solution of the gold would have gone on indefinitely after successive precipitations.

As gold is very readily reduced from highly dilute solution by the action of organic matter and of sun-light, it was important to ascertain wherein sea-water differed from ordinary water in its action on gold, or, rather, wherein lay its power to retain gold in solution in presence of organic matter. This power was proved to reside in the iodate of calcium present in sea-water by the follow-

* The precipitation of gold from sea-water by chloride of barium seems scarcely explicable, unless by supposing the gold to be present in the sea-water as an aurate, so as to be thrown down as aurate of barium. This view has much in its favour, and is greatly supported by the fact that if oxalic acid is added to sea-water some time before the addition of chloride of barium, it is scarcely possible to detect gold in the precipitate formed. And this is easily to be understood, since oxalic acid reduces all gold salts; and in so dilute a liquid—that is, a liquid in which any gold reduced is so finely divided—any precipitation of such gold, unless under the conditions described in the *methods I. and* III., could not be expected to take place.

* Some years ago, having occasion to make a great number of assays for the precious metals in specimens taken from the mountains of Reumammawr, in North Wales, I was greatly puzzled by the conflicting results obtained with the same reagents, but under different modes of working. Specimens smelted before the blowpipe always gave much higher results than those that were treated in crucibles. For in the former case I used only borax as a flux, and in the latter, to make the mixture more fusible, and also to ensure a good button of lead, I used, besides borax, carbonate of sodium or of potassium and charcoal powder. Nevertheless, even in the latter case, beads of auriferous silver containing also platinum were always obtained; for the proportion of iron oxides contained in the mineral was not large enough entirely to prevent the solvent action of the lead upon the precious metals. But more recently on assaying a series of red hæmatite ores found in the Isle of Man, I obtained from some specimens treated before the blowpipe, with a good proportion of borax, as much as 16 ozs. silver to the ton; while the same specimens smelted in crucibles as described, left a spongy mass of iron, and the lead button contained *no silver*. I repeated the experiments often enough to leave no doubt respecting the cause of these discrepancies being that referred to in the text. I also sent samples of these ores, containing from 4 to 16 ozs. silver to the ton, to eminent assayers, who informed me that they contained *no trace* of the precious metal.

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ing direct experiment.* A drop of gold solution was added to about 400 c.c. of rain-water, and the solution was divided into two equal parts, to one of which a tenth of its bulk of solution of iodate of calcium containing 1 part iodate to 1000 of water was added, A drop of the same gold solution was added to 400 c.c. sea-water, and another drop to a corresponding quantity of iodate of calcium solution. The beakers containing the four solutions were placed, uncovered, in sun-light. All the solutions except that of sea-water became perceptibly coloured after a few hours, and next day were distinctly ruby-coloured, the sea-water remaining colourless. After another day or two, however, all had become nearly colourless, except the pure solution of gold, which remained permanently coloured. The disappearance of the colouration could only arise from solution of the precipitated gold, since subsidence was out of the question. Ruby liquids so dilute as these I have found not to lose colour by subsidence for months. Many similar experiments have been made under varied circumstances, all showing that solution of iodate of calcium has absolutely no solvent action on gold, nor even the power to prevent its reduction from solution. But so soon as the iodate itself undergoes partial decomposition under the influence of putrescible matter, iodine is liberated, and gold, if present, is dissolved.

REPORT UPON THE CHEMICAL AND ALLIED PRODUCTS SHOWN IN THE DUBLIN EXHIBITION.

The Dublin Exhibition so far has been a success, mainly owing to the fine Art Collection of pictures, and what is termed the Loan Collection. There is not much novelty as regards the chemical and other products shown, but what is there is excellent in quality. They are all British and Irish exhibitions, with the addition of a few Colonial ones. It is generally supposed that the Exhibition will close at the end of November, although this has not been officially announced. The following are the Exhibitors who will probably interest our readers.

Messrs. J. C. and J. Field, London.—This celebrated firm exhibits many articles of interest, particularly in the candle line. They are also probably the exhibitors of the greatest novelty in this branch of manufacture, namely the ozokerite candles. This fossil resin was first mentioned by Meyer, who discovered it in Moldavia in connection with coal and rock-salt. The source of the candles made by Messrs. Field is a product from the Carpathian Mountians, which seems to have been first submitted by Dr. Letheby to the notice of that firm in 1868. They seem to have surmounted all the practical difficulties incident to the purification of this unpromising brown substance, and have produced the most beautiful candles in appearance which have yet been made. The characteristics of the crude ozokerite which is shown is as follows:—Its colour is brown, with a wax-like lustre when burning. Its odour is of the aromatic hydrocarbons. It is said to have a sp. gr. of 0·94, and melts 66° C. It distils without decomposition, and is not altered by strong acids. It slightly differs in chemical and physical properties according to the source from whence it is derived, and the above description applies more to the specimens of crude ozokerite shown by Messrs. Field and Co., and examined by the writer. It is, when purified, a variety of paraffine having the following composition:—

Carbon	85·75
Hydrogen .. .. .. : ..	15·15
	100·9

Nothing can exceed the beauty of the candles as made by Messrs. Field and Co. from this unpromising looking substance; and it would appear from the report of Dr. Letheby, that they exceed any other yet introduced as regards illuminating power. He gives the number of grains required to give the light of 1000 grains of the best spermaceti candles as follows:—

Ozokerite candles	754
Various paraffine candles	798 to 891
Sperm candles	1000
Wax candles	1150

As it has a very high melting-point; it does not bend or soften; it is, in fact, a much harder material than ordinary paraffine. It would be out of place to deal with Messrs. Field's numerous specialities in a periodical like the Chemical News; they are ingenious, and make up one of the most interesting cases in the Exhibition. For instance, the tinting of paraffine candles mauve and magenta with aniline colours is a great improvement upon the old opaque mineral colours. As regards paraffine candles, this firm claims priority over all others in the introduction of them to the public. They say, "We claim the merit of being the first in the English trade to manufacture for general sale, paraffine candles, and to have mainly contributed to their success, &c." Messrs. Wm. Brown and Co., of Glasgow, were actually the first makers in 1855, but to show the great stride that this article of industry has made, we may mention that in the letter addressed by Messrs. Field to the Secretary of the Exhibition of 1862, they state that whilst the candle was introduced at a price of 2s. 4d., and with a consumption of 3 to 4 cwts. weekly, it was at this time sold for 1s. 5d. This firm used 3 to 4 tons weekly; and in 1867 the total English make was some 2000 tons annually.

Messrs. Price and Co.—There is nothing particularly new about the case of this firm. It is certainly very handsome, and the contents excellent, but it is a mere reiteration in saying this of the articles turned out by the said firm. Added to which, all chemists must look at Messrs. Price and Co. with respect as the originators of pure glycerine, and the promulgators of a great chemical fact. Although distilled glycerine is now extensively manufactured abroad, the originators hold the palm as regards quality. This is mainly due to the fact of its great freedom from acrid products of distillation, which give a disagreeable odour to the glycerine if nothing worse. Glycerine can be, and frequently is, re-distilled by the aid of superheated steam. Very inferior glycerine is now in the market, but its genuineness is so easy of detection, that we are surprised to find such inferior qualities are sold at a high price. Pure glycerine should not give a white precipitate with nitrate of silver, and the resulting mixture should not deposit a precipitate on exposing it to the sun's rays. It should volatilise on heating a small quantity on a platinum foil without leaving a carbonaceous residue; and it should be quite destitute of odour. The "solidified glycerine" is a soap which is stated to consist of 25 per cent of pure glycerine.

* I do not by this mean that solution of iodate of calcium has any power to dissolve gold, or to retain it in solution when dissolved by any *direct* action. But, as has been shown in former papers, putrescible organic matter causes liberation of iodine in a neutral or slightly alkaline solution of iodate of calcium, and the iodine thus liberated continuously dissolves the gold that is being continuously precipitated, if such an expression referring to nascent conditions may be permitted. It is clear from the experiments given in the text, that organic matter is capable of precipitating gold *earlier* than the stage at which that balance of destructive and conservative forces always at issue between organised and inorganic matter arrives at which iodate of calcium begins to decompose, such decomposition leading the liberation of iodine, which, as shown, reacts upon any precipitated gold to dissolve it. From these premises we may easily see how, although sea-water must always retain some gold in solution, it may yet, under circumstances not only conceivable, but such as must necessarily occur in regions where the passage of organic matter to a state of putrescence is too rapid for the *formative* power of the iodate of calcium in sea-water to keep pace with it, cause precipitation of gold. Hence it is, as it appears to me, that gold-fields are found richer in tropical regions where decomposition goes on at a quick rate, than in colder regions where the re-forming power of iodate of calcium can exercise a more powerful solvent action upon the gold which sea-water has extracted from the original material of which the earth is composed.

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Mr. John G. Rathborne, Dublin.—One of the most important Irish exhibitors is Mr. Rathborne, the contents of whose case are *bona fide* specimens of home manufacture. He is a wax-bleacher, and is one of the few firms from whom you can procure pure white wax; although the public have been educated to prefer the prettier article which is now sold under the name of *cera alba*. This house also works paraffine, but its chief interest is the refining of sperm oil and the manufacture of spermaceti. The head-matter of the sperm whale is a semi-crystalline mass of a very dirty and offensive appearance. It is separated into two distinct portions, the fluid, or sperm oil is clarified, and extensively used for lubricating and illuminating purposes. On its freedom from the crystalline portion mainly depends its commercial value; and so well is this understood that certain seasons of the year are considered preferable to others for its manufacture. The crystalline solid portion, or cetin, $C_{32}H_{64}O_2$, when purified by pressure and treated with alkalies, constitutes the spermaceti of commerce, which differs considerably, and more frequently than ordinary observers would imagine, owing to the variable quantities of sperm oil still remaining. The specimens of spermaceti shown (both crystallised and manufactured into other forms) are certainly the finest we ever saw as regards purity in this respect, which is mainly gained by hydraulic pressure.

Messrs. C. Ogleby and Co, London, exhibit candles and other products.

Newry Salt Company.—Different varieties of salt are shown by this Company; they are procured from rock-salt, and are beautifully pure.

Cantrill and, Cochrane, Dublin, show mineral and medicinal waters.

Messrs. McMasters, Hodgson, and Co., Dublin, are expressers of linseed oils, and rape oils. They also show the respective cakes, and some other proprietary articles, such as fluid annatto, all excellent preparations.

Messrs. Boileau and Boyd, Dublin.—The case belonging to this firm contains an interesting collection of chemicals, some of them rare. They have been arranged most artistically; and we noticed one very fine specimen of them made by crystallisation from damaged tea. It is used in medicine as a tonic and stimulant in doses of 1 to 5 grains.

The starch exhibitors are not very numerous, but are remarkably good, particularly the Irish manufacturers. It is perhaps, not generally known that Ireland is celebrated for its wheat-starch amongst the trade. With the general public rice has supplanted wheat-starch, owing to the fact that the outer envelope of the granules is more easily broken, and the starch can be made without boiling. Such, however, is not the case with the wheat granules, which require boiling to make the starch. It, however, possesses remarkable stiffening properties, which makes it invaluable for technical purposes. Thus whilst the rice-starch is used by the public, the wheat-starch is used by the Manchester houses.

The exhibitors of starch are as follows:—

J. and J. Colman, London.—Laundry starch prepared from rice, and also rice-starch prepared for dietetic purposes under the name of "Corn Flour."

Charles Cooney and Son, Dublin.—Laundry starch prepared from wheat.

John Kelly, Graigne.—Rice and wheat-starch for laundry purposes; very good.

Alex. Crawford and Son, Belfast.—Wheat-starch for laundry purposes, beautifully white. Wheat-starch prepared for dietetic purposes under the name of Irish corn flour. In speaking of their preparations they make the following remarks:—

The *Snow-white Starch* is a special manufacture of the firm remarkable for its beautiful colour, its great purity and strength; and is now used by the principal bleachers and finishers in the kingdom in the preparation of the finest goods. It is made from wheat alone, and retains its stiffening power for any length of time. It is supplied to the Royal Laundry, and gained the gold medal, London, 1870.

The *Irish Corn Flour* is a novelty in this line, being also made from wheat, and therefore possessing the many advantages of that cereal over its competitors rice, Indian corn, and sago; from which the previous corn flours have been made. It is a beautiful white colour, is highly commended for its flavour and fresh pleasant taste, it has great nourishing power, and is adapted to every variety of table use.

The mining exhibitors are not numerous, but are interesting. The first case in importance as well as show, is that of the—

Mining Company of Ireland.—This company has generally been a prosperous one, but under the very peculiar abnormal circumstances attending our coal supplies, we have no doubt that it will with the assistance of Mr. Harold, and their efficient staff of officers, be able to realise a rich harvest. All the works and property of this Company were, some years since (when the writer visited them), an honour to the country as illustrating the manner in which large manufacturing operations might be conducted in a cleanly, methodical, yet in an effective manner. Their lead and silver mines are situated at Glendalough, at the end of the valley which contains the celebrated ruins known as the "seven churches." One entrance to the old mine is about one-third of the way up the mountain. The mountain is bored right through, so that the levels go from one valley to the other. This old working is eighty fathoms deep (480 feet); and besides this they are now rapidly piercing the mountain for new workings. It has been calculated that to raise 1800 tons of dressed lead-ore fit for the market, 46,000 tons of ore are broken by the miner. The rejected stuff is blend, fluor-spar, quartz, and calx-spar. None of these are made available for the market. Very rare minerals have been found in these valleys. Gold, metallic silver, witherite, heavy spar, carbonate of lead. Blend is found in large quantities, but is not worked. About 1·3 per cent of the whole of the lead ore raised in the world is procured from this mine. Ireland yields also about 2·4 per cent of the whole of the silver raised in the world, or about £3850 per annum. The silver is procured by Patterson's process from the silver-lead, which is manipulated at the works of the Company situated at Ballycorus. The lead is converted into pig, sheet, shot, and pipe. They also procure litharge in the refining of the silver, red-lead (manufactured), and arsenic, which sublimes during the smelting of the lead, also antimony. Lead is extensively procured for type-founders, and shot. One of the most important points in connection with the Mining Company of Ireland, however, are their collieries.

The very important question of the price of coal and its supply will probably be ultimately and mainly regulated by Ireland; at any rate as regards its present abnormal inflated condition. The resources of the Irish coal were never thoroughly appreciated, but the writer has no hesitation in saying that the already known or worked mines are sufficient to compete with English coal, if enough energy and capital were only invested in them. Again, the behaviour of the Irish Railway is suicidal to the extension of this branch of industry. Let us take this Company alone. They are working at the present moment the "Bonlea," "Ballinastick," "Coalbrook," "Earlshill," and "Foilacamin" collieries. They are situated in the county of Tipperary. At the present moment they raise annually 50,000 tons, 45,000 tons of which are culm. Besides this, at their collieries at Cork, they raise annually 10,000 tons. It is chiefly anthracite of the very best quality, containing as much as 96 per cent of carbon: it may, in fact, be practically viewed as pure carbon; and is so much valued for some special purposes, such as malting, that 32s. are eagerly paid in Dublin for this coal. It is, although a flameless coal, valuable for steam purposes. We have been credibly informed that for the carriage of this coal, 2s. per ton is charged from

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Limerick Junction to the town of Tipperary, a distance of 2¼ miles. How can the resources of a country be developed in the face of such restrictions? There is certainly something here that requires explanation. The culm is used chiefly in lime-burning, for which it is particularly suited. Anthracite requires a great draught, but is one of the most valuable fuels we possess, both as regards the intensity of heat produced, and its freedom from sulphur. From Berthier's experiments on the reduction of oxide of lead, we find that anthracite stands very high; yet the sample he experimented upon was not equal to the Irish in quality (viz., Pennsylvania). Wigan cannel produces 28·3 parts of lead; Newcastle 30·9; Glasgow 24·9, and anthracite 30·5.

General Mining Company of Ireland, Dublin.—Calamine and oxide of zinc are shown in all their stages of manufacture. This Company possesses at the silver mines in Tipperary the largest deposit of calamine in the United Kingdom; and they manufacture their oxide directly from the ore. The oxide is generally made from spelter. By their process, which is a patent, the Company can make oxide very cheaply, but as it is made directly from the ore the resulting oxide always contains lead, which vitiates to a certain extent its value as a pigment when made by this process. The mining Company are anxious to prevent this by some modification of their process, because if such a change could be brought about the spelter oxide could not compete with it in price. They also show caustic soda made by a patent process in which the inferior brands of oxide are utilised for the production of this article.

This latter process is one which the above named Company are now experimentally determining the merits of. The patentee is a Mr. Crockford.

Connoree Mining Company, Dublin.—Pyrites and copper ores from their mines in Wicklow, &c., and specimens of copper by precipitation. Most of the ingots of gold got in this country have been found in the workings of this Company.

The Geological Survey of Ireland.—The geological maps of Ireland, published by the survey.

Greenagh Colliery, Dungannon.—Specimen of cannel coal, Coal Island, Dungannon. Used in the manufacture of gas, and marked 35s. at colliery.

Val de Travers Company.—Specimens of natural asphaltes used in the pavements laid by this Company.

Messrs. Millard and Robinson, Dublin.—There is nothing particularly novel in the way of photographic processes exhibited, if we except some beautiful specimens shown by Messrs. Millard and Robinson. The following seems to be the *modus operandi* by which these excellent results are obtained. An ordinary silver print upon albumenised paper is taken, and the minute defects are painted out with the ordinary tube oil colour thinned with turpentine only. When dry, it is immersed for 30 minutes in water, so as to thoroughly soften the paper, and finally in water at 65° C. A plate of glass, which should be scrupulously clean, is warmed to about 90°, and a solution of Nelson's transparent gelatine is poured over the surface of the glass quickly and so as not to chill the gelatine, and the print is lifted from the warm water and laid face downwards upon the gelatine solution. It must then be carefully and dexterously manipulated, so as to press the print in close contact with the glass, and to expel the superfluous gelatine solution. All air bubbles must be excluded. If a flat plate of glass is used the manipulation will be easy, but by preference convex, or oval convex, or lunette glasses give much better effects. The gelatine solution is made by macerating the transparent gelatine for 12 hours in cold distilled water, pouring off the superfluous fluid and applying heat to melt the gelatine, when it will be found to have just absorbed the requisite quantity and to dissolve thoroughly. It is strained through fine muslin, and is then ready for use. Simple as this process may seem, the effects must be seen to be appreciated. Thus the details in the deep shadows will be brought out in a "*fixe*" which would not be visible in the ordinary print. Mr. Robinson, who has introduced this process, also claims, for the photographs thus treated, permanency. He says, "Some idea of the effects of this method of treating photographs may be obtained by taking a photo-print and sizing one half, and comparing the effect produced with the unvarnished half. The glass replaces the varnish, and it is evident that no varnish can compare with the glass in the qualities which make, or give, value to a varnish."

The other exhibitors who might possess an interest for the readers of the CHEMICAL NEWS, are as follows:—

Piston Freezing Company, London.—Patent freezing machines, seltzogens, and other apparatus.

J. Spencer and Son, Dublin.—Jellet's saccharometer (fully described in the CHEMICAL NEWS, vol. xi., p. 294), and other philosophical instruments.

Dublin Glass Bottle Company, North Lotts, Dublin.—Specimens of glass in various stages of vitrification, and bottles in all their stages of manufacture.

Walker, Campbell, and Company, Liverpool.—Hains's patent lead encased block-tin pipe. The proprietors of this pipe state that they have succeeded in combining the two metals, tin and lead, in such a way as to render them in the form of a pipe perfectly homogeneous, the result of this combination being, that the pipe possesses all the ductability and pliability of the lead with the innocuous nature and tenacity of the tin. They also say that, although the cost per ton is double that of the ordinary lead-pipe, the weight per yard required for a given pressure is only half, therefore the cost is the same. Thus Hains's patent pipe by experiment was ½ inch inside diameter, the weight per yard 4·017, the extension was 13·6 per cent, and the bursting pressure was 1859 lbs. per square inch. With common lead-pipe the inside diameter was ½ inch, the weight per yard was 7·13 lbs., the extension was 9·7 per cent, and the bursting pressure per square inch 1579. Dr. Lankester said he had submitted these pipes to the action of distilled water, Thames, and other waters, and neither lead nor tin could be detected in the water. Also acid decoctions seem to be without action upon the tin.

Messrs. Bryan Corcoran, Witt, and Co., Mark Lane, London.—Specimens of wire-weaving for sifting, &c., Iron gauze, containing 10,000 holes to the inch, and brass wire gauze 150 holes to the inch are shown.

W. S. Rumsey, London.—Various polishing and other pastes.

Bermondsey Indian-Rubber Works, London.—Indian-rubber in all its stages and in the raw state.

D. Tallerman, 90, Cannon Street, London.—Australian preserved meats, meat extracts, &c.

James Tennant, jun., Smithfield.—Specimens of minerals from Nova Scotia, St. Helena, Algoa Bay, and South Africa. Collected by the exhibitor during his travels.

Anti-Adulteration Society, Dublin.—Products used in adulterating. Adulterated manures, &c.

Thomas G. White, Dublin.—Charcoal, pyro-lignite, acetate of lime, acetate of soda, acetic acid, &c., from the destructive distillation of Irish wood.

John Somerville, Gas Company, Dublin.—These are a very complete series of products illustrative of the destructive distillation of coal in the process of gas making. Mr. Somerville is the engineer to the extensive gas works in this city, and besides all the direct products of distillation, such as carbolic acid, benzoin, toluol, &c., he shows all their derivatives, including the anthracene derivatives and the aniline colours.

Messrs. Berger Spence and Co., Manchester.—This firm exhibits a beautiful crystal of alum; the specimen being made from coal shale, pyrites, and refuse from the ammoniacal gas works. This fine crystal exhibits a very faint amethyst tinge.

Messrs. Boyd and Alexander, Dublin.—Chloride of lime (38 per cent), commercial acid, manures, &c.; a good collection.

Marine Salts Company, Dublin and Galway.—A very excellent collection, illustrative of the products manu-

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factured by this Company from sea-weeds collected upon the west coast of Ireland. They exhibit iodine, bromine, and the accompanying salts; also the principal sea-weeds from which the kelp is derived with their relative value in iodine given—*e.g.*, *Laminaria digitata*, *Laminaria saccharina*, rich in iodine; *Fucus serratus*, poor in iodine.

Dublin and Wicklow Manure Company.—Good specimens of commercial acids, manures, &c.

Messrs. Bewley and Draper.—Mineral waters and dichroic ink. The preparations of this firm are so well known and appreciated in Ireland that it is superfluous to dwell upon them.

Messrs. Yeates and Son, Dublin.—This firm shows astronomical telescopes and spectroscopic apparatus. The compound prisms for the latter are very beautifully made.

Amongst the soap makers there are two that require special mention.

Messrs. Holt, Nerwich, and Co., Vauxhall Walk, Lambeth, London, exhibit pure oil soaps for technical purposes. The light oil soaps are made for using with silks, poplins, and woollen goods. The black oil soaps are half the price, but of course can only be used for black goods. The great advantage claimed for these soaps are that they never congeal, and may be used indifferently in hard, soft, and salt waters. The soaps were examined by the reporter, and found to be genuine cheap soaps perfectly saponified. The amount of causticity was slight (= 1·8 per cent soda). The specimen was almost entirely soluble in spirit, the residue being only 1·6 per cent, whilst the amount of moisture was comparatively low for a new specimen of soap, viz. 18 per cent. Such soaps are no doubt valuable adjuncts to the trade.

Messrs. Fred. Lewis, and Co., Fleet Street, Dublin, are worthy of more than simply their names appearing as soap and perfume makers, from the fact that they manufacture largely much of the exported soaps that go to our Colonies. They also, some time since, contradicted and exposed a statement that was going the round of the scientific world, that the perfumed soaps, such as windsor, &c., were made from horse-green. In the higher class of perfumed soaps, the actual cost of the soaps used (which are generally two) is a secondary consideration. They show a pillar of perfumed soap which is probably the largest ever cast in one piece; and show beautiful samples of curd and white windsor. The soaps shown by Messrs. Lewis, and Co. are perfectly neutral.

British Seaweed Company, Dalmuir, Glasgow.—Mr. Edward Stanford's well-known process for manufacturing the products of seaweed are well known, and the importance of his patent must be felt with the present high price of iodine. The remarkably large produce of iodine must give them a decided advantage. The increased produce is due to the non-volatilisation of the iodides, such as occurs during the ordinary process of the burning of the kelp. A series illustrating their process is given in the case, also one showing, the carbon closet system, which has been fully described in the CHEMICAL NEWS, vol. xxv., p. 75. The method of excretal removal is a modification of the earth closet system, in which some form of carbon is substituted for earth. By the use of charcoal the amount of deodoriser required is reduced to less than a fourth as compared with earth, and a constant supply is secured. The system is being adopted by many of the large public works.

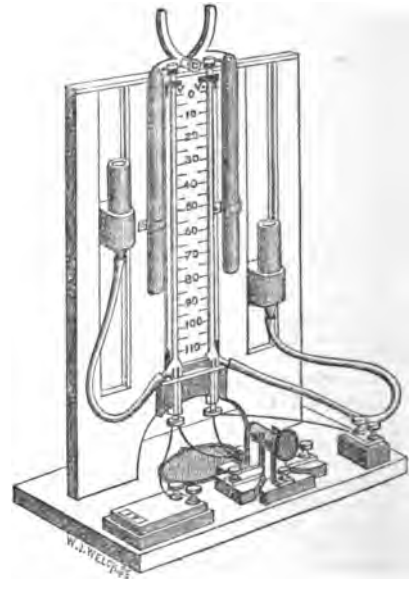
ON MEASURING TEMPERATURES BY ELECTRICITY.*

By C. WILLIAM SIEMENS, D.C.L., F.R.S., M.R.I.

(Concluded from p. 154).

ALTHOUGH I have explained that, by means of a differential galvanometer and a variable resistance (constituting in effect a Wheatstone bridge arrangement), the increasing resistance of the platinum spiral may be measured, it was found that the use of a delicate galvanometer is attended with considerable practical difficulty in iron-works and other rough places where it is important to measure elevated temperatures, or on board ship for measuring deep sea temperatures. I was therefore induced to seek the same result by the conception of an instrument which is independent in its action from tremulous motion, or from magnetic disturbance caused by moving masses of iron, and which requires no careful adjustment or special skill on the part of the operator. This instrument is represented by Fig. 4, and may be termed a chemical resistance measurer or "differential voltameter." The immortal Faraday has proved that the decomposition of water in a voltameter expressed by the volumes of gases V,

FIG. 4.



is proportionate in the unit of time to the intensity, I, of the decomposing current, or that—

$$I = \frac{V}{T}.$$

According to Ohm's general law, the intensity, I, is governed by the electro-motive force, E, and inversely by the resistance, R; or it is—

$$I = \frac{E}{R}.$$

It is therefore—

$$\frac{V}{T} = \frac{E}{R} \text{ or } V = \frac{ET}{R};$$

or the volume, V, would give a correct measure of the electrical resistance, R, if only the electro-motive force, E, and time, T, were known and constant quantities. But the electro-motive force of a battery is very variable; it is influenced by polarisation of the electrodes, by temperature, and the strength and purity of the acid employed. The volume of gases obtained is influenced, moreover, by the atmospheric pressure, and it is extremely difficult to make time observations correctly. It occurred to me, however, that these uncertain elements might be entirely eliminated in combining two similar voltameters in such a manner that the current of the same battery was divided between the two, the one branch comprising the unknown resistance to be measured, and the other a known and constant resistance. The volume of gas, V^1, produced in

* Read before the Royal Institution of Great Britain,

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ınd voltameter, having a resistance, R^1, in circuit, e expressed by—

$$V^1 = \frac{ET}{R^1},$$

ıhould have the proportion of—

$$V : V^1 = \frac{ET}{R} : \frac{ET}{R^1};$$

d T, being the same in both cases, may be struck the expression will assume the simple form—

$$V : V^1 = R^1 \div R.$$

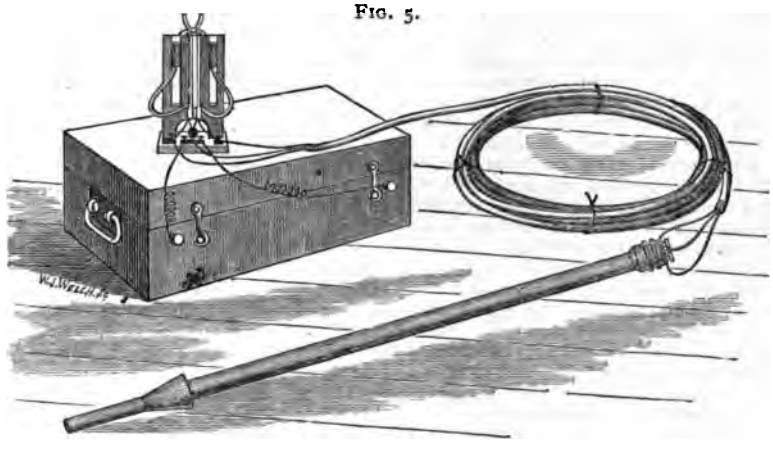
ıtant resistance, R, of the one circuit being known, s that the unknown resistance, R^1, is expressed

$$\frac{R^v}{V^1};$$

say, by a constant multiplied by the proportion ɔduced in the two voltameters irrespective of time, th of battery, or temperature, or the state of the r.

sistance, R and R^1, are composed each of two prising the permanent resistance, R, and the leading wires up tc the pyrometer, and the other the leading wires and the pyrometer coil. If the resistance of the pyrometer coil should be equal to the permanent resistance, R, the R^1+y will be equal to $R+y$, and therefore $V=V^1$, but as the resistances differ, so will the volumes. Necessary conditions are: that both reservoirs are filled with the same standard solution of pure water with about 10 per cent of sulphuric acid, that all the electrodes are of the same form and size, and that their polarity is reversed frequently during the progress of each observation, in order to avoid unequal polarisation. With these precautions, which involve no particular skill or knowledge of electrical observation on the part of the operator, very accurate results are obtained; but in order not to incur considerable error of observation, it is advisable to continue the current, reversing the same say twice, until at least forty divisions of gases are produced in the least activated tube, which operation will occupy from two to three minutes; if a battery of from 4 to 6 Daniell elements is employed. The volumes, V and V^1, being noted, after having allowed half a minute for the gases to collect after the current has ceased, the weighted cushions upon the tubes are raised,

FIG. 5.



:s, viz., that of the principal coils, which we may · R^1, and of the voltameter and leading wires, he same in both cases, and may be expressed he expression should therefore be written as –

$$V : V^1 = R^1 + y^1 : R + y,$$

the unknown quantity.

chanical arrangement of the instrument will be d from the diagram, Fig. 4; and the whole ent of the pyrometer, with its leading wire and measurer, from the general view given in Fig. 5. metric resistance measurer consists of two cali- rtical tubes of glass of about 3 m.m. diameter, fixed upon a scale showing arbitrary, but equal

The upper ends of the tubes are closed by small of india-rubber pressed down upon the openings of weighted levers, whereas the lower portions es are widened out and closed by plugs of wood, which the electrodes in the form of pointed wires penetrate to the depth of about 25 m.m. idened portions of the tubes. By a side branch, ed portion of each vertical tube communicates, by an india-rubber connecting-pipe, to a little glass containing acidulated water, and supported in a lide. In raising the weighted cushions, closing ends of the vertical tubes, and in adjusting the f the small reservoirs, the acidulated water will h tubes to the zero line of the scale. In turning n front of the tubes, the battery current is passed oth pairs of electrodes, the one circuit com- in order to allow the gases to escape, when the water levels will immediately return to their zero position, to make ready for another observation. By inserting the observed values for V and V^1 into the expression above given, the unknown resistance, R^1, can be easily calculated; but, in order to facilitate the use of the instrument, I have prepared a Table which gives at a glance the resistance due to any two observed volumes, the volumes V governing the vertical, V^1 the horizontal columns, and the resistance being read off at the point of intersection. At each point of intersection the resistance is marked in black, and the corresponding temperature in red ink.

It now remains only to be shown what is the relation between the resistance and temperature in heating a platinum wire. The researches of Dr. Matthiesen, who has made the latest investigations on the effect of temperature upon electrical resistance, are restricted to the narrow range of temperatures between 0° and 100° C., nor do they comprise platinum. He adopted the following general expression for the pure metals:—

$$R_t = \frac{R_0}{1+xt+yt_2},$$

which, in determining the specific values of x and y for each metal, gives a close agreement with observation between the narrow limits indicated, but is wholly inapplicable for temperatures exceeding 200° C., when the value t^2 commences to predominate and to produce absurd values for R_t.

It was necessary for my purpose to undertake a series

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of elaborate experiments with a view of finding a ratio of general application. Coils of thin wire, of platinum, iron, copper, and some other metals, were gradually heated and cooled in metallic chambers containing the bulbs of mercury thermometers, and for higher temperatures of air thermometers, and the electrical resistances were carefully noted. The progressive increase of electrical resistance was thus compared directly with the increasing volume of a permanent gas (carefully dried) between the limits of zero and 470° C. and a ratio established, which is represented by the formula

$$R_t = aT_t^2 + \beta T + \gamma,$$

in which T signifies total temperature counting from the absolute zero, and a β and γ specific coefficients for each metal. According to this formula the electrical resistance is a constant at the absolute zero, and progresses in a ratio represented graphically by a tipped-up parabola, approaching more and more toward a uniform ratio at elevated temperatures. Although the comparison with the air thermometer could only be carried up to 470° C., the general correctness of the ratio of increase just stated has been verified by indirect means in measuring progressive heats, and by comparison with the platinum ball pyrometer.

It is important to mention here that great care must be exercised in the selection of the platinum wire for the measuring spiral, platinum wire having been met with conducting only 4·7 times better than mercury at zero, C., and others; conducting 8·2 times better than mercury, although both samples had been supplied by the same eminent makers, Messrs. Johnson and Matthey. The abnormal electrical resistance of some platinum wire is due chiefly to the admixture of iridium or other metals of the same group, and it appears that the platinum prepared by the old welding process is purer and therefore better suited for electrical purposes than the metal consolidated by fusion in a Deville furnace.

In conclusion, I shall show some working results of the pyrometer in measuring by means of the same protected coil a mixture of ice and water, boiling water, molten lead, and the fire itself by which the lead is melted, the readings produced being 2° C., 98° C., 330° C., and 860° C. respectively. The latter temperature signified a cherry-red heat, as may be judged by the appearance of the tube when withdrawn from the fire. The instrument which I have had the honour to bring before you this evening has already received several useful applications. Through its first application an important telegraph cable was saved from destruction through spontaneous generation of heat. Professor Bolzani, of Kasan, has made some interesting applications of it for recording the temperature at elevated points, and at points below the earth's surface. Mr. Lowthian Bell has used it in his well-known researches on blast-furnace economy; and at several iron works pyrometer tubes are introduced into the heating stoves, and permanently connected with the office, where the heat of each stove can at all times be read off and recorded. These and other applications are sufficiently self-evident, if the soundness of the principles upon which I rely is conceded; but I feel that the shortness of time at my command has hardly enabled me to do more than pass these in review, while endeavouring to demonstrate the results obtained of recording the temperatures of distant or inaccessible places, including furnace temperatures.

ON DYES AND DYE-STUFFS OTHER THAN ANILINE.*

By Dr. F. CRACE CALVERT, F.R.S.

(Concluded from p. 152).

I SHALL now proceed to give you a brief outline of the characteristic differences of the several tannin matters.

* The Cantor Lectures, delivered before the Society of Arts. Revised and communicated by the Author.

Gall-nuts are the most valuable and important of all tannin matters. They are produced by the female of an insect called *Cynips*, which pierces the buds on the young branches of the *Quercus infectoria*, a tree growing especially in the East. There she soon deposits her eggs, and the bud loses its natural growth, and swells out to the size of a hazel-nut, having a green, red, or pink colour. The eggs thus inclosed soon hatch, and the insect undergoes all its metamorphoses until it attains the perfect state, when, if allowed (which is not to the interest of either the gatherer or consumer), it makes a hole and escapes. Good gall-nuts should not be so pierced, and they should be heavy, and of a fresh green colour. If the insect has escaped they are yellow, and are not of nearly so good quality.

In the market, they generally bear the name of the port from which they were shipped. Thus, there are Aleppo gall-nuts, which are considered the best in the market, then the Morea, Smyrna, &c.

The following may be considered as the composition of an average sample of gall-nuts:—

Tannic acid	65·0
Gallic acid	2·0
Ellagic acid } Luteo-gallic acid }	2·0
Chlorophyl and volatile oil	0·7
Brown extractive matter	2·5
Gum	2·5
Starch	2·0
Lignine	10·5
Sugar, albumen, &c., and ash	1·3
Water	11·5
	100·0

Gall-nuts are employed to produce blacks on silks, in the preparation for Turkey-red, to produce fast blacks in calico-printing, and, lastly, large quantities are used in the manufacture of pyrogallic acid, the consumption of which, in the present large requirements of photography, must be enormous. We shall see, as we proceed, that gall-nuts are the only available tannin matter for the production of this acid.

An inferior quality of gall-nut is also sold, which is found on the *Quercus*, called *Knoppern*, which grows in Hungary, Styria, Croatia, and Piedmont. It is used in those countries for tanning leather, and in some parts of Germany as a cheap substitute for the Eastern nuts.

Sumach is, as Dr. Stenhouse's researches show, the only substance in which the tannin principles are identical with those of gall-nuts, although in this tannin matter there is a comparatively large quantity of gallic acid. It also contains a soluble yellow principle.

Sumach is found in commerce as a coarse powder obtained by the trituration of the young branches and leaves of several varieties of the family *Terebanthaceæ*. The species most cultivated is the *Rhus coriaria*, which is a plant indigenous to Italy, Sicily, France, Spain, and Portugal. The shrub grows to a height of 16 feet in the most arid soils, and is very extensively cultivated in some of those countries. The twigs and leaves are gathered once a-year.

Although sumach varies greatly in the amount of tannin it contains, there can be no doubt that from the *Rhus coriaria* is the best, whilst the most inferior comes from the South of France, and is the produce of the *Coriaria myrtifolia*.

In consequence of the powdered state in which sumach is sold, it not only varies greatly in quality, but is often deliberately adulterated with sand, or the leaves of other plants. It is easy to discover the sand, it being only necessary to put some of it in water, when the sand, from its greater specific gravity, readily falls to the bottom of the vessel. I will describe the method of determining the amount of tannic acid later on.

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Extract of sumach is sometimes employed in print-works, to produce yellows with acetate of tin, blacks and greys with iron mordants, and dark yellow with sulphate of zinc. It is also used to produce blacks on woollen fabrics, although it does not give as good blacks as gall-nuts. Its principal use, however, is to mordant, either alone or in conjunction with salts of tin, the cotton warps of the mixed fabrics so extensively manufactured in Yorkshire, by which means the cotton takes the same colours as the woollen weft, both with vegetable dye-stuffs and those derived from coal-tar.

Sumach is too expensive a tannin matter to be used for the tanning of leather, but it is employed by the currier in the preparation of skins for dyeing with light shades.

Valonia is the acorn-cup of the *Quercus ægilops*, which grows in the isles of the Grecian Archipelago and on the coasts of Asia Minor. It is especially employed for tanning leather and adulterating garancine.

Divi-divi is the pod of the *Cæsalpina coriara*, and is chiefly imported from South America.

Myrobalans, which are largely used for tanning leather and producing blacks on wools, are the dried fruit of the *Terminalia chebula*, and are imported chiefly from Calcutta.

Dr. Stenhouse has shown that the tannin matter of valonia, divi-divi, myrobalans, and oak bark, are not identical with those of gall-nuts and sumach. They do not yield gallic acid when boiled with dilute sulphuric acid, but sugar and some other organic principle.

From the above facts it must be obvious to all who use tannin matters, whether dyers or tanners, that these substances not only vary in value, according to the variety of plant from which they have been obtained and the country whence they are imported, but there are sources of deterioration which cannot be detected by the eye. Thus, for example, if a new sumach be mixed with a comparatively old one, it is impossible to detect the fraud. The only method, therefore, of ascertaining the value of a sample is to determine chemically the amount of tannic acid it contains. This may be done by the following process:—A weighed quantity (say 100 grains) of the substance to be tested is boiled with distilled water, and the decoction run off into a beaker, without filtering. This process is repeated four or five times. A test solution is prepared by dissolving 1 drachm of gelatine in 4 ounces of water, and adding 15 grains of powdered alum to the solution: 155 grains of this solution represent 5 grains of pure tannic acid. The test fluid is carefully dropped into the beaker until, on the falling of a drop upon the surface, the characteristic ring of tannate of gelatine is no longer produced. The quantity of test fluid used is then ascertained, and from this the amount of tannic acid is calculated.

Before passing from this class of tannin substances, there is one that I must mention, which has been used from the most ancient times, in Egypt, Arabia, and other Eastern countries, to dye wool, horse-hair, leather, &c. It is the leaves of the *Lawsonia inermis*, which appears to be the gopher wood of Scripture and the henna of the Egyptians. The leaves are mixed with water, to form a paste of an orange-brown colour. This paste also is employed by the Asiatic ladies to dye the nails of their hands and feet, as well as their ears and hair.

Catechu, *gambier*, and *gum-kino* are the most valuable of the tannin substances, which give a green colouration with per-salts of iron. They are most extensively used to produce a great number of shades, varying from light drabs to dark brown, in cheap dyed cotton goods, such as fustians and corduroys. They are used in calico-printing chiefly to produce browns, in silk dyeing to weight the silk, and in tanning to produce a low class of leather, easily distinguishable from that properly tanned with bark and other matters belonging to the first class, because when used for making shoes it communicates to the stockings a peculiar orange-yellow hue.

For a long time there was much doubt as to the genus of plants from which catechu, gambier, and kino, which resemble each other very closely in their properties, were derived. M. Guibourt, a few years ago, solved the problem. He found that real *catechu*, or *cutch*, was obtained from the wood of the palm called *Areca catechu*, and the *Acacia catechu*, whilst gambier is extracted from the leaves of the *Uncaria gambir*, *terra japonica*, belonging to the family *Rubiaceæ*, and kino is obtained principally from the *Butea frondosa*, a leguminous plant.

Catechu is found in commerce principally in two states; the best in lumps varying in weight from 80 to 90 lbs., of a dull purple colour, and covered with leaves; the second in masses, more or less covered with sand.

Gambier is imported into this country in the form of small cubes, having a yellowish-brown colour.

Good catechu should not leave, on incineration, more than 4 or 5 per cent of ash. Its aqueous solution should give, with alcohol or gelatine, an abundant white precipitate, with lime and baryta a brown precipitate, with salts of lead and tin a yellow precipitate varying in shade with the salts employed, and with bichromate of potash a brown precipitate. It should also take a decided brown hue with alkalies, and assume a greenish colour with salts of iron.

Catechu, besides naturally varying widely in quality, is freely adulterated with mineral substances, starch, tannin matters, and blood.

I have just stated the amount of ash a good catechu should yield. To ascertain the presence of starch, the sample should be first treated with alcohol, and the insoluble residue boiled with water, which will give a fine blue colouration on the addition of iodine if starch be present. The presence of any ordinary tannin matter in the catechu will modify the green colouration which the latter substance gives with the per-salts of iron. Blood may be detected, if present, by treating the catechu with alcohol, and, after drying the insoluble residue, heating it in a tube, when ammoniacal vapours will be given off, as well as vapours of a most offensive odour.

Catechu is composed of three distinct substances,—first, a tannin matter called *mimo-tannic acid*; second, *catechine*, or *catechinic acid*; and, lastly, a brown colouring matter due to the oxidation of the catechine.

Mimo-tannic acid is prepared by treating pulverised catechu by ether in a displacement apparatus. The ethereal solution leaves, on evaporation, a yellow porous mass of this acid. Bombay catechu yields about 55·5 per cent of mimo-tannic acid; that from Bengal, 48·2 per cent; while gambier yields from 36 to 40 per cent.

Catechine, or *catechinic acid*, is obtained by treating with boiling water the residue from catechu, which has yielded its mimo-tannic acid to ether. The water on cooling deposits a brown crystalline precipitate, which is re-dissolved in water, and yields with sub-acetate of lead, and the precipitate washed. The lead compound is then suspended in water, and decomposed by sulphuretted hydrogen, when pure catechine remains in solution. Its formula is $C_{10}H_{10}O_4$. It rapidly becomes coloured brown in the presence of air, and an alkali, being, it is said, converted into *japonic acid*, whilst, with alkaline carbonates, it yields *rubinic acid*. It is also converted into japonic acid under the oxidising influence of salts of copper and of bichromate of potash.

If dyers, instead of employing catechu as imported, were to grind it, and wash with cold water, they would obtain an extract which would yield very pure shades of green drabs, while the insoluble residue of catechine would give a great variety of shades of brown. To increase the permanency of catechine colours, the goods dyed with them should be passed through a solution of bichromate of potash, as is usually done for catechu browns.

Dr. Stenhouse has shown that the tannin matters giving a green colouration with per-salts of iron, such as

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catechu and elder and larch barks, do not contain a glucoside. The only exception he has found to this rule is willow bark.

PROCEEDINGS OF SOCIETIES.

SCIENTIFIC AND MECHANICAL SOCIETY, MANCHESTER.

AT the last monthly meeting of the above Society, which was held on Wednesday, the 4th of September, a resolution was unanimously passed—"That a special committee be appointed to take into consideration the Society's future programme, and to make the necessary arrangements for carrying out the same. This committee to revise the existing or draw up new rules, and organise additional sections to their own (the engineering section), representing the staple industries of the district in all its most important branches, similar to the well-known Société Industrielle de Mulhouse, to consider the advisability of taking immediate steps for the establishment of a Technical Reference Library and Reading Room, and the publication of the Society's proceedings. The mover of the resolution in his remarks said it was hoped there would at least be a section devoted to Technical Chemistry, another to Spinning and Manufacturing, &c., for the coming session, which would begin in November. If we looked upon that eminently useful and authoritative body, the Société Industrielle de Mulhouse, it was difficult to understand that a similiar movement should not have been set on foot in such an important centre of industry as Manchester was long ago; but it seemed evident that it simply required a start, it was clear that there was ample scope and an urgent want for such an extension of their Society. He hoped that those gentlemen who mooted the subject in letters published some time ago in the CHEMICAL NEWS would join and co-operate with them.

A committee with full powers was then elected, consisting of Messrs. Von Hohenhausen, Dreyfus (analytical chemists), Hilton (manufacturer), Spriggs, Lynde (mechanical engineers), Tolhausen, Ziffer, Ross (civil engineers), Hacking and Hildebrandt (civil engineers), the hon sec. of the Society.

This committee held its first sitting on the Wednesday following, and appointed deputations to wait upon gentlemen of influence and practical experience representing chemistry and engineering, and willing to take an active part in their labours.

At the second committee meeting, which was held the following Wednesday, Messrs. Richard L. Messtayer, C.E., and Charles J. Allport, M.E., were added to the committee, and at the last meeting, held last Wednesday, the 25th inst., at the "Trevelyan" Hotel, Messrs. F. Spence (Pendleton Alum Works), John Gilchrist (ditto), Hart (Messrs. Tennants and Co.), Evan, Levinstein, and James N. French, gentlemen engaged in chemical manufacture, attended, and were elected members of the committee, all expressing their conviction that a movement of the kind as contemplated was a great desideratum, and promising their hearty co-operation.

Thus it will be seen that a very important point has been settled: There will be a Chemical Section, and efforts will also be made for the organisation of a technical library and reading room. Arrangements will be made that the sections meet on different days, so that each member of the Society may be able to attend each meeting if he so chooses. It is hoped that after sections may be organised in due course, and those gentlemen desirous to co-operate with the committee or to become members of the Society—the name of which will probably be altered also—are requested to communicate with the hon. sec., *64, Freme* Street, Manchester.

CORRESPONDENCE.

NEW PROCESS FOR ANALYSING COMPOUND ETHER.

To the Editor of the Chemical News.

SIR,—Allow me to state in your columns that one of the processes for analysing compound ethers, brought before the British Association at its recent meeting, by Prof. Wanklyn, viz., heating the ethers with an alkali and estimating the amount of alcohol liberated, has already been described by myself as long ago as the year 1867, and will be found fully explained in the *Journal of the Chemical Society* of that year, as also in the work on Wine by Dr. Thudichum and myself.—I am, &c.,

A. DUPRE, Ph.D.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, September 23, 1872.

This number contains, in addition to several original papers and memoirs relating to mathematics, natural philosophy, geology, astronomy, and natural history, the following original papers relating to chemistry:—

New Method for Preparing Chromic Acid.—E. Duvillier.—The process consists in the decomposition of chromate of baryta by nitric acid. 100 parts of the chromate of baryta, 100 of water, and 140 of nitric acid (sp. gr. = 1·384) are boiled together for ten minutes; it is essential that the water be first added to the chromate, so as to form with it a kind of thickish magma, to which the nitric acid is next added. After ebullition, there are added 200 parts of water, and then the mixture is again boiled for ten minutes; on cooling, the greater part of the nitrate of baryta is deposited in crystalline state, but, after decantation, a further evaporation is required to eliminate the rest of the nitrate of baryta, which, however, may be got rid of by means of dilute nitric acid, thus yielding a solution of chromic acid, which crystallises after evaporation to a small bulk. By this method, very pure chromic acid is obtained, while none is left behind in combination with the baryta.

Different Vibratory Motions Produced by Explosive Compounds.—P. Champion and H. Pellet.—This essay contains the record of a series of experiments made with the view of studying the vibratory motions caused by the explosion of iodide of nitrogen, fulminates, and nitro-glycerine. It appears that, under certain conditions, the vibrations produced cause musical sounds to be distinctly recognised.

Journal de Pharmacie et de Chimie, September, 1872.

This number contains the following original papers and memoirs more particularly relating to chemistry:—

General Method of Immediate Organic Analysis.—Dr. Fleury.—The conclusion of this monograph. This portion is divided into the following sections:—Treatment with cold water; treatment with boiling water; treatment with dilute hydrochloric acid; treatment with caustic potassa; distillation with water; distillation with acidulated water; distillation with an alkali.

Existence of an Organic Alkali in Boldo.—E. Bourgoin and C. Verne.—The boldo is a tree, a native of Chili, belonging to the natural order of the *Mominiaceæ*, described by Baillon as *Peumus boldus*; the leaves of this tree have an aromatic camphor-like taste, and contain an essential oil, and an alkaloid which the authors term boldine, which is extracted from the dry and previously-pulverised leaves by first eliminating the essential oil and other complex volatile principles, and next treating the residue with alcohol at 90 per cent containing tartaric acid in solution. By a rather tedious and lengthy process of purifying, the boldine (the leaves operated upon by the authors only contained 1-1000th part of that substance) is set free; it is difficultly soluble in water, to which it imparts, however, an alkaline reaction and very bitter taste. Boldine crystallises, is soluble in alcohol, ether, chloroform, and benzine, and, when dissolved in acids,

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it is precipitated by ammonia and by the double iodide of mercury and potassium; with iodine-water, this solution yields a chestnut-brown colour; nitric and sulphuric acids impart in the cold a red colour to boldine.

Although not strictly belonging to chemistry, we call attention to the following excellent memoir:—

Report on Absinthe.—MM. Boudet, Dubail, and Adrian.—The authors, having been requested to make a full inquiry into this subject (absinthe being very largely abused in France), have thoroughly investigated the matter, and come to the conclusion that the *liqueurs d'absinthe* are strictly dangerous poisons.

Bayerisches Industrie und Gewerbe-Blatt, September, 1872.

This number contains the following original communications and papers relating to chemistry and collateral matters:—

Rules to be Observed in the Management and Firing of Steam-Boilers so as to Prevent Explosions.—W. Born.—Valuable advice concerning the care to be taken with all that relates to steam-boilers.

Coating of Metals with Nickel by the Aid of Galvanism.—Prof. Böttger.—This lengthy essay treats not only on the electro-nickeling of metals, but also on electro-plating in general.

New Method of Gas-Lighting.—Dr. G. Feichtinger.—This paper, illustrated by a woodcut, contains the detailed account of an ingeniously-contrived and simple arrangement by which benzoline is applied, without a wick, for the production of a cheap and brilliant light, which is already largely applied in many parts of Germany.

Treatment and Removal of Stains of Various Origin from Woven Fabrics.—Dr. L. Rigler.—In a tabulated form, the author gives brief, but useful, hints for the suitable treatment of stains of various nature on dyed, as well as white, woven fabrics of silk, wool, cotton, and flax.

Annales de Chimie et de Physique, October, 1872.

This number contains the following original papers and memoirs:—

Researches on Dulcite and on Sugars in general.—Dr. G. Bouchardat.—The conclusion of the monograph on this subject.

Expression of the Elastic Force of a Saturated Vapour in Relation to Temperature.—L. Saint-Loup.—An algebraico-physical essay.

Spontaneous Ascension of Liquids in Capillary Tubes.—C. Decharme.—Illustrated by engravings and several tables exhibiting the results of experiments.

The American Journal of Science and Arts, September, 1872.

In addition to original papers relating to astronomy, natural philosophy, natural history, geology, and palæontology, this number contains the following paper bearing on chemistry:—

Red Oxide of Zinc of New Jersey.—A. A. Hayes.—This mineral, which has been known for some forty years, has often been the subject of scientific research, on account of its peculiar colour, and the contents of this memoir are mainly devoted to the discussion of the cause of that colour. The composition of the mineral, in 100 parts, is—Oxide of zinc, 93·48; protoxide of manganese, 5·50; scales of specular iron, 0·44; ferric deutoxide, 0·36; loss, 0·22. According to the author, the colour exhibited by this mineral is due to a silicate of zinc, calcium, and ferric oxide, which is dispersed through the mineral in mica-like fashion. Some specimens of the mineral carnallite present a full rich red colour, due to a similar cause, viz., the mica-like dispersion of specular iron scales through it.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, October, 1872.

Applications of Electricity.—Th. du Moncel.—A report by the author on several electrical apparatus constructed and improved by Trouvé. This memoir, illustrated by woodcuts, contains a detailed account of improved galvanic elements, electro-magnetic apparatus for medical use, apparatus for military telegraphy, and apparatus for extracting rifle-balls from wounds.

Report on the Artificial Manure and Works of MM. Dunod and Bougleux.—J. Barral.—The detailed description of the bone-black and artificial manure works situated at Aubervilliers, near Paris; very perfect and excellently working apparatus are in use for condensing the volatile products derived from the carbonisation of bones.

Relation of the Eye and the Ocular Glasses chiefly in Use in Optical Instruments.—F. P. Leroux.—The concluding portion of this essay, illustrated by woodcuts and engravings.

Metalliferous Mines of France, not including Iron Mines.—A. Caillaux.—The conclusion of this essay.

Pharmaceutische Zeitschrift für Russland, No. 12, 1872.

This number contains the following original papers relating to chemistry:—

Testing of Quinine for Adulterations.—J. Biel.—1 part of sulphate of quinine is dissolved in the smallest possible quantity of dilute sulphuric acid; next, 12 parts of ether and excess of ammonia (2 parts) are added, and this mixture, contained in a test-tube, is well shaken up; a white-coloured turbidity and crystalline precipitate indicate the presence of cinchonine. 1 part of sulphate of quinine is rubbed up in a mortar with 20 parts of a decimal solution, at 15°, of Seignette salt (tartrate of potassa and soda; the fluid is next filtered, and, to 5 parts of the filtrate, 1 part of ammonia (sp. gr. = 0·96) is added; a white turbidity of the previously shaken-up liquid indicates the presence of β-chinidine. The residue of the former operation is next treated with 20 parts of a solution of sulphate of soda (1 to 3), and, to 5 parts of the filtered solution, 1 part of ammonia is again added; a white turbidity indicates cinchonidine. 5 c.c. of the cold saturated aqueous solution of pure sulphate of quinine require 4 c.c. of ammonia (sp. gr. = 0·92) to yield a clear solution. 5 c.c. of the aqueous solution of pure sulphate of quinine and 10 per cent of β-sulphate of chinidine gave, with 5 c.c. of ammonia, a strong turbidity, which was got rid of by the addition of 4 c.c. more of ammonia; but, after two minutes, a crystalline precipitate appeared, which required the further addition of 10 c.c. to render the liquid clear. Pure sulphate of quinine, mixed with 10 per cent of cinchonidine sulphate, 5 c.c. of solution, and 5 c.c. of ammonia, yielded an opalescent fluid, which was rendered quite clear by the addition of 3 c.c. of ammonia, but, after five minutes, the precipitate was stronger than before. 5 c.c. of the solution (aqueous) of pure sulphate of quinine and 10 per cent of sulphate of cinchonine yielded, upon the addition of 5 c.c. of ammonia, a strong precipitate, which was hardly dissolved by the addition of 200 c.c. of ammonia.

Detection of Caffeine in Tea-Leaves.—E. Lieventhal.—The description of a rather complicated process of extracting caffeine from tea-leaves by exhaustion of the same with chloroform.

Nos. 13 and 14, 1872.

These numbers only contain original papers relating to pharmacy and pharmacognosy.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, June 24, 1872.

New Mode of Treatment of Scraps of Tin-Plate for the Purpose of Obtaining the Tin Coating from it.—M. Ott.—This paper contains a brief *resumé* of the several methods proposed to recover the metallic tin coating which covers the material known as tin-plate, and a detailed description is given of a process invented by the author; it consists mainly in the methodical treatment of the scraps of tin-plate, first with acid, then with water, then with alkali, and again with acid; the tin is precipitated from its solution by means of metallic zinc, and the spongy metal thus obtained is next molten.

Frigorific Apparatus.—Ch. Tellier.—The description, illustrated by a woodcut, of a peculiarly constructed ice-safe, so arranged as to be a neat piece of useful furniture.

Preparation of Chlorine by a Continuous Process.—Tessié du Motay.—This process is based upon the following reactions:—Peroxide of manganese is first gently heated in a retort, in contact with hydrochloric acid gas; chlorine is evolved, while there is left in the retort chloride of manganese and water—

$$MnO_2 + HCl = 2HO + MnCl + Cl.$$

The chloride of manganese thus obtained is next heated to dull red heat in a fire-clay retort, and decomposed by means of a current of steam into hydrochloric acid and sesquioxide of manganese, but if, along with the steam, there is mixed a sufficient quantity of air or oxygen, there is produced a mixture of chlorine and hydrochloric acid, while peroxide of manganese is regenerated. The hydrochloric acid last mentioned may be converted into chlorine by simply causing air (without any steam at all) to pass at dull red heat over the chloride of manganese—$MnCl + O_2 = MnO_2 + Cl$.

New Process for Bleaching Woollen and Silk Fabrics.—Samal and Beronson.—In order to wash the suint from wool, and the gum from raw silk, the authors apply a more or less concentrated and more or less warm (up to 50°) solution of an alkaline sulphuret or aluminate.

Les Mondes, September 19 and 26, 1872.

These numbers contain no original papers relating to chemistry or collateral subjects.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, May, 1872.

This number contains no original papers relating to chemistry or collateral subjects.

Journal für Gasbeleuchtung und Wasserversorgung, No. 15, 1872.

This number contains no original papers relating to chemistry, but we call attention to the following memoir:—

Report on the Results of the Competition for Water-Meters, as required by a Programme Issued by the Directors of the City of Hamburg Water-Works.—J. A. Samuelson, C.E.—This paper contains valuable information concerning water-meters.

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PATENTS.

Communicated by Messrs. VAUGHAN and Son, Patent Agents, 54, Chancery Lane, London, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

2596. J. Hargreaves and T. Robinson, Widnes, Lancashire, "Improvements in the manufacture of salt."—Petition recorded August 31, 1872.

2610. J. Noad, Hackney Wick, Middlesex, "Improvements in the manufacture of paper pulp from wood, and in apparatus therefor."—Petition recorded September 2, 1872.

2642. C. W. Torr, Aston, near Birmingham, and J. Johnstone, Birmingham, "Improvements in furnaces for heating and melting metals and metallic alloys."

2644. J. Harvey, Vere, Jamaica, "Improvements in the manufacture of sugar, and in apparatus therefor."—Petitions recorded September 5, 1872.

NOTICES TO PROCEED.

1476. R. C. Menzies, Valleyfield, Midlothian, N.B., and A. E. Davies, Worcester, "Improvements in the manufacture of pulp for paper-making."—Petition recorded May 15, 1872.

2429. T. J. Denne and A. Hentschel, Mile End, Middlesex, "Improved combination of ingredients for treating, preparing, stiffening, and thickening raw, felted, spun, and woven fibres and fabrics, also for use in dyeing and printing such fabrics and fibres."—Petition recorded August 15, 1872.

2454. W. Ferrie. Airdrie, Lanarkshire, N.B., "Improvements in connection with furnaces for smelting iron."—Petition recorded August 17, 1872.

PATENTS SEALED.

835. N. Prada, Trebbin, near Berlin, Prussia, "Improvements in preserving animal substances, and in agents for the purpose."—Partly a communication from P. Toninetti, Trebbin.—Dated March 19, 1872.

865. J. Werner, Mannheim, Baden, Germany, "An improved composition to be used as a substitute for 'brewer's pitch' for lining vats, casks, and tubs, and for other like purposes."—Dated March 21, 1872.

880. H. Hollefreund, Havelberg, Prussia, "Improvements in the treatment of potatoes, maize, corn, millet, and other starch-containing vegetable matters, to obtain saccharine and other products therefrom, and in apparatus employed therein."—Dated March 22, 1872.

908. G. J. Snelus, Dowlais, Glamorganshire, "An improved lining for cupola furnaces, also applicable to the formation of the beds of reverberatory furnaces."—Dated March 25, 1872.

943. A. Beveridge, Leith, N.B., "Improvements in preparing, cleansing, and refining animal fats, and in the means and apparatus employed therefor."—A communication from A. Jurgens, Oss, North Brabant, Holland.—Dated March 30, 1872.

1586. W. R. Lake, Southampton Buildings, London, "Improved processes and apparatus for the extraction of oil and the production of flour from maize."—A communication from H. C. Cavayé, Paris.—Dated May 24, 1872.

2261. W. E. Gill, Salisbury Street, Strand, "Improvements in treating vegetable juices, and in the apparatus and materials to be employed therefor."

2263. G. T. Bousfield, Sutton, Surrey, "Improvements in furnaces for deoxidising iron ores, preparatory to their being worked into wrought iron."—A communication from J. Wilson, Dover, New Jersey, U.S.A.—Dated July 29, 1872.

PATENTS GRANTED IN BRITISH COLONIES.

MAURITIUS.

LIST OF PATENTS GRANTED FROM 1838 TO 1872, BOTH INCLUSIVE.

1. J. B. Hélie, "Purifying sugar."—Dated November 14, 1838.

2. P. L. W. Terrasson and C. Lieber, "Purifying and filtering cane-juice in the manufacture of sugar."—Dated August 24, 1840.

9. H. A. Hugnin, "Purifying sugar."—Dated February 15, 1845.

12. P. Bernard, "Purifying sugar."—Dated September 4, 1847.

14. W. Bojer, "Manure from night-soil."—Dated November 22, 1849.

18. V. N. Monneron, "Guano, manufactured from sea animals, plants, and other ingredients of this island,"—Dated February 18, 1853.

19. J. Brandees, "A new process for the manufacture and purifying of sugar, &c."—Dated April 23, 1853.

20. E. Deschiens, "Wine from sugar-cane."—Dated May 27, 1854.

21. L. Wray, "A new process for employing the plant called *Holcus saccharatus* in the manufacture of syrup, molasses, sugar, vinegar, &c., and also for the treatment of the cold raw juice of the said *Holcus saccharatus*, or of any other cold raw saccharine juice, with lime and other suitable substances, and then the filtration of the said juices."—Dated February 7, 1855.

24. G. Garbert, "Disinfecting pulverised charcoal."—Dated March 14, 1856.

25. A. Raynaud, "Spirits of wine distilled from rum and brandy."—Dated August 27, 1856.

26. C. Lieber, "A new process for manufacturing rum."—Dated *March 9, 1857.*

34. A. P. D'Esmery, "Artificial manure for agricultural purposes more particularly adapted for the cultivation of sugar-canes."—Dated March 25, 1859.

35. A. P. D'Esmery, "A composition to be used as a disinfectant and for the cure of sores."—Dated November 26, 1859.

36. Dr. H. F. Fressanges, "A composition to be used as a disinfecting and deodorising agent."—Dated December 6, 1859.

40. P. Boilesve, "A new method of defecating sugar and other saccharine matters and of refining or rectifying alcohol."—Dated June 9, 1860.

47. F. Martial, "Vermicelli and macaroni."—Dated July 2, 1861.

50. H. I. V. Portal, "A process for purifying the juice of the sugar cane, and which process consists in a special mode of employing lime for the purpose, and in also employing some carbonate or neutral sulphite."—Dated November 13, 1861.

53. A. Maurel, "Compound gas (in a liquid state) consisting of of schist and certain substances combined therewith."—Dated January 31, 1862.

54. C. Molet, "Artificial manure, possessing the same qualities as Peruvian guano."—Dated May 5, 1862.

57. A. Toulorge and P. Maurice, "A new process for manufacturing sugar."—Dated September 16, 1862.

60. Ali-Ben-Sou-Alle, "Paste for the manufacture of paper."—Dated October 24, 1862.

61. F. I. Rivière, "A process for the destruction of the 'borer'."—Dated January 20, 1863.

62. C. Bernard, "A process for the manufacture of spirits."—Dated March 31, 1863.

63. G. Davies, "Improved process for the manufacture of sugar."—Dated April 6, 1863.

66. E. T. and E. B. de Gemini, "An improved process for bleaching and clarifying sugar and other saccharine matters."—Dated June 6, 1863.

69. A. Joly, "Manure by means of hydrated oxide of phosite."—Dated August 16, 1864.

75. A. Rampant, "Improved process for manufacturing sugar."—Dated May 28, 1866.

77. G. Garbert, "Artificial disinfecting and deodorising charcoal."—Dated June 12, 1866.

78. G. Garbert, "A process for preserving and colouring timber by injection of preservative solutions and dyes."—Dated June 12, 1866.

81. A. Robert, "A process for extracting the saccharine particles left in the 'bagasse' (cane hash)."—Dated March 19, 1867.

84. F. I. W. Minchin, "Improved process for extracting the juice from the sugar-cane, beet-root, and other plants."—Dated May 16, 1867.

89. G. d'E. de Charmoy, "Improvement in the mode of manufacturing sugar."—Dated April 18, 1868.

90. A. Robert, "A process for converting syrup sugars and syrup into 'Veson' sugars."—Dated April 18, 1868.

94. Dr. E. Icery, "A process of decoloration and purification of cane-juice by the protosulphite of oxide of calcium."—Dated December 29, 1868.

96. I. G. G. H. Griffiths, "Soap prepared by a combination of subcarbonate of soda and other substances with water and oil."—Dated April 22, 1869.

102. E. Boivin and D. Loiseau, "Improving the manufacture and refining of sugar by using for that purpose a product termed 'saccharate of hydrocarbonate of lime,' obtained by the introduction of carbonic acid into a calcareous saccharine solution."—Dated February 10, 1870.

103. W. O. Giles, "An improved mode of preserving animal and vegetable substances by placing such substances in a heated chamber so as to evaporate their moisture, and afterwards by penetrating such substances with heavy vapours from a retort containing coal-tar oil, resin, or other oleaginous substance capable of being vapourised by the application of heat."—Dated February 21, 1870.

108. G. d'E. de Charmoy, "A new process to disinfect human excreta to be afterwards changed into manure."—Dated November 5, 1870.

111. A. Robert, "An essential improvement in obtaining fine sugar from syrups or molasses."—Dated December 15, 1870.

112. A. Robert, "An essential improvement in the mode of extracting sugar from cane hash."—Dated December 15, 1870.

118. Dr. J. Mailloux, "A process for the defecation and clarification of cane-juice and syrups by means of porcelain clay or kaolin, or hydrated silicate of aluminium."—Dated March 31, 1871.

120. C. A. de Bragard, "A new mode of refining ordinary and low sugars."—Dated June 30, 1871.

121. J. Hall, "A process for the preservation of meats and provisions."—Dated July 25, 1871.

124. G. d'E. de Charmoy, "A chemical compound both to deodorise night-soil and to make the same more effectually applicable as a manure to agricultural purposes."—Dated October 6, 1871.

125. T. Hill, "Saccharine material, called 'saccharum'."—Dated October 17, 1871.

TO CORRESPONDENTS.

A. H. A.—Normandy's "Commercial Analysis" is published by Lockwood and Co., price 9s.

A. M.—Wagner's "Chemical Technology" is published by J. and A. Churchill, price 25s.

J. R.—Consult "Kerl's Metallurgy," by Crookes and Rhodig, published by Longmans and Co.

J. Baker, T. Fletcher, W. King.—Received with thanks.

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THE CHEMICAL NEWS.

VOL. XXVI. No. 672.

THE AMMONIA PROCESS OF WATER ANALYSIS IN INDIA.

By EDWARD NICHOLSON, F.C.S., Assist.-Surg. R.A.

I OWE some amends to Messrs. Wanklyn and Chapman for having, some months ago, hastily depreciated their ammonia method of estimating organic matter in water. The best amends I can make is to give an account of the results obtained by the process, both in my own experience and in the published results of other analysts' work. The first specimen of official results I saw were rather wild; whether *grms.* had been misprinted for *milligrms.* I know not, but "albumenoid ammonia 0·1750 grm. per litre" in a good spring-water looks peculiar, There is no appearance of misprint about it, and I attributed the extraordinary amount to the eccentricity of the condensing arrangements in the government apparatus.

I since have had access to the Reports of the Bengal water analyses, and find that in 1869 Dr. Macnamara, Chemical Examiner to Government, and in 1869-70 Dr. Palmer, his substitute, made ammonia examinations of the waters of Calcutta and the neighbourhood; I am thus enabled to compare the results obtained by two successive analysts on the same waters.

I have been able to trace examinations of three or four waters for several successive seasons; peculiarly enough, each examination appears to yield more and more ammonia, though the organic matter by the permanganate does not increase notably.

		Centigrms. per litre.		
		NH_3.	Alb. NH_3.	Oxygen of Permanganate.
Old tank on the glacis of Fort William, supplied by surface drainage*:—	April, 1867.	—	—	0·25
	Jan., 1869.	0·008	0·025	—
	Feb., 1869.	0·007	0·038	—
(After the rains).. ..	Nov., 1869.	0·002	0·052	0·09
	Dec., 1869.	0·009	0·090	0·19
	Jan., 1870.	0·005	0·034	0·16
	Feb., 1870.	0·004	0·098	0·17
New tank on the glacis of Fort William; can be filled from the river Hoogly*:—	Sept., 1866.	—	—	0·18
	April, 1867.	—	—	0·12
(After the rains).. ..	Sept., 1867.	—	—	0·06
	Jan., 1869.	0·006	0·035	—
	Feb., 1869.	0·007	0·051	—
(After the rains).. ..	Nov., 1869.	0·004	0·056	0·09
(Partially re-filled from the river)	15th Dec., 1869.	0·010	0·040	0·31
(Filled)..	20th Dec., 1869.	0·008	0·050	0·12
	Feb., 1870.	0·019	0·084	0·11
	May, 1870.	0·008	0·100	0·07
Hoogly river:— At Barrackpore, above Calcutta	Jan., 1869.	0·005	0·008	—
	,, ,,	0·007	0·008	—
At Calcutta ..	Dec., 1869.	0·008	0·013	0·06
	12th Feb., 1870.	0·007	0·022	0·06
	24th ,, ,,	0·012	0·022	0·06

There are considerable discrepancies in the above results; for instance, the new tank water, requiring 0·09 centigrm. of permanganate oxygen, and containing 0·056 centigrm. of albumenoid ammonia, is filled up from a comparatively pure river; the permanganate oxygen increased to 0·31 centigrm., and the albumenoid ammonia decreases somewhat. If, as is likely, the disturbance of the water caused an increase of oxygen to be consumed by oxidisable matter, the albumenoid ammonia should have increased also. With the subsidence of the water, the quantity of permanganate used fell rapidly to the original amount, while the albumenoid ammonia still increased. I can understand, in this case, the results of the permanganate much better than those of the ammonia process.

The increased amount of permanganate required led the Chemical Examiner into a curious error; he says, "fresh water had been pumped in from source which, though less impure in most respects (albumenoid ammonia) contained a loathsome amount of impurity." A few weeks afterwards he finds that the tank was re-filled from the river Hoogly, and examines the river-water with the results given above. I strongly suspect these albumenoid ammonia figures are much less trustworthy than those of the permanganate.

Within the last few days I have received the "Report of the Madras Water Examinations" for the year 1871. One of the analysts, Mr. Harvey, has been for some years assistant to the successive Professors of Chemistry in the Madras Medical College; I know that his work can be relied on as conscientious, and his results will therefore afford a fair criterion. From his connection with the chemical department of the Medical College, he would have access to corks, india-rubber tubing, and such like necessaries for fitting up apparatus, enabling him to work the ammonia process without difficulty.

The details I unfortunately cannot give, owing to the muddle which the compiler or the printer has made of the analyst's figures, 0·06, 0·006, 0·0006, and 0·00006 grm. being evidently interchangeable; the whole report, as far as figures go, is full of mistakes. Mr. Harvey says, of the waters of St. Thomas's Mount:—

"By the permanganate, as well as by the ammonia process, the quantity of organic matter found is remarkably small; and, assuming the albumenoid ammonia obtained to express the purity, or otherwise, of drinking waters, with one exception, none of these waters exceed the standard laid down by Messrs. Wanklyn and Chapman for a pure water, the albumenoid ammonia obtained ranging from 0·03 to 0·08 per million. They may, therefore, be regarded as waters of very great purity, and unquestionably well adapted for drinking and other domestic purposes." However, seven out of twelve of these well-waters are too brackish to be potable.

The Palaveram waters examined by the same analyst were much of the same character. The best well (containing 20 centigrms. of total solids, 2 of which were chlorine, requiring 0·04 centigrm. of permanganate oxygen, and yielding 0·05 centigrm. of albumenoid ammonia) was in a locality used as a rubbish and sweepings depot; it was only 18 feet deep. This shows the little effect of surface pollution on sub-soil water.

The analyst at Rangoon gives figures for the results of the ammonia process, but they are of such a peculiar character that I hardly like to quote them; numbers such as 0·0032 grm. of ammonia and 0·0006 grm. of albumenoid ammonia are common. A good well-water requiring 0·0010 grm. of oxygen is said to yield 0·00470 grm. of ammonia and 0·0040 grm. of albumenoid ammonia.

Three examinations of water from the Rangoon lake, a beautiful piece of clear and pure water with which I am well acquainted, are said to have given the following results:—

	Grm. per litre.		
	(*a.*)	(*b.*)	(*c.*)
Ammonia	·0006	·0012	·0008
Albumenoid ammonia..	·0016	·0014	·0016
Permanganate oxygen	·0010	·0011	·00107

I cannot consider the determination made by the ammonia process at Rangoon as being in any way trustworthy.

The analyst at Secunderabad did not give any results of the ammonia process; and, considering that the apparatus supplied to the analysts consisted of a retort and a clumsy copper condenser that would not condense (without the slightest means of connecting the two), he acted wisely.

* The water of the above tanks is, after filtration, the drinking-water of the European troops in garrison.

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For my own part, I made no systematic ammonia examinations until I had got out apparatus of my own; at the end of the year I began the process, and have obtained the following results from various waters:—

Wells.	Centigrms. per litre. Ammonia.	Alb. Ammonia.	Oxygen of Permanganate.
The Dhobies wells, Bangalore; water 6 feet from the ground, percolated from the Ulsoor tank through a gravel bed; 16 wells all communicating:—			
(1). A well not in use, ground clean ..	0·0005	0·005	0·015
(2). A well in use, ground trampled into mud by the bullocks carrying water to the troops; water drawn by leathern buckets..	0·0020	0·008	0·020
(3). A well on the ground now used by washermen; clothes constantly washed close to the well	0·0020	0·026	0·040
A well in Bangalore gaol, conservancy perfect	0·0010	0·006	0·010
A well, very open, water kept low by constant draught; supplies Artillery horse-troughs	0·0060	0·010	0·240
Water from the above well, filtered at barracks; filter receptacle open and not looked after..	0·0030	0·026	0·230
A well, large and open, used solely for supplying barracks, by means of an aqueduct; ground perfectly open, irreproachable, and the well guarded; the water is always yellow, from *humic* organic matters; of excellent quality	0·0030	0·021	0·300
A large open well, with steps; people constantly going down to fill their water-pots, wading for a little distance in the water; water covered with *Conferva crispa*; in great demand	0·0060	0·020	0·060
A well in great use, very muddy all round from trampling of bullocks; ground open, conservancy otherwise good	0·0030	0·024	0·030
Tanks.			
Water supplied to troops from the water-works at Ulsoor tank; the water, before filtration, is opaque with yellow clay; after filtration (through 5 feet of sand) it is clear and good; the conservancy of the tank is very good, but the vegetation is entirely conferval..	0·0020	0·014	0·080
A tank without vegetation, except *Conferva*; greenish coloured water, with much water fleas; water in great demand	0·0070	0·022	0·140
A small tank, in which people are all day wading to fill their water-pots; water turbid and swarming with water-fleas; no vegetation; conservancy good	0·0100	0·043 (1st., 0·046) (2nd., 0·041)	0·080

It is not easy, in the present state of our knowledge, to draw conclusions as to the standards of purity exigible from Indian waters, or as to the interpretation we should give to the figures representing organic impurity. As far as I can see, good waters vary exceedingly; the following standards appear to be approximately applicable:—

Well Waters.	Alb. NH_3.	Permanganate Oxygen.
Standard; good filtering soil; water clear and colourless, not much disturbed in drawing	0·007	0·02
The same, but much disturbed; ground muddy	0·015	0·04
Open reservoir-wells, with vegetation, disturbed by peoples feet, &c.	0·020	0·10
Tank Waters.		
Standard; not much vegetation; well filtered from animalculæ and suspended matters..	0·015	0·10
Much vegetation	0·020	0·30
Little vegetation; much animalculæ	0·025	0·10

Quantities above the standards should lead the analyst to examine how far they may be due to pollution by putrescent or organic matters. No water should be condemned without being judged on the full evidence derived from—

(*a*). Mineral matters compared with those of good waters in the same drainage-basin.

(*b*). Organic matters estimated by ammonia process and the permanganate test.

(*c*). Examination of physical properties.

(*d*). Full inquiry into the condition, past and present, of the drainage-ground.

The seventh well in the above list is an example of a water that would be condemned if the evidence of the organic matter were alone taken. Thorough examination showed that the organic matter must be of humic origin; the water is perfectly wholesome and pleasant.

On the whole, I may say that the ammonia process gives a fairly accurate estimate of the amount of nitrogenised organic matter in the water, but other evidence must be adduced in order to show the origin of the nitrogenised substances. I find that there is a good deal of difficulty in getting rid of the free ammonia, and am disposed to think that much of it properly belongs to the albumenoid ammonia. With regard to the applicability of the process to Indian sanitary requirements, I think that India is too far backwards yet for it, and that it is too delicate to be trusted in the hands of analysts and others who have received no chemical education.

ON A PROBABLE CHEMICAL AND INORGANIC ORIGIN OF THE ATLANTIC OOZE AND THE CHALK.

By THOMAS P. BLUNT, M.A., F.C.S.

A very probable and ingenious answer has lately been suggested to the question, "Why is the sea water salt?"—an answer which carries conviction with it, because it shows, by a prior reasoning, that the sea must necessarily contain large quantities of chloride of sodium, or at least of soluble chlorides. The process of reasoning may be stated as follows:—

A constant distillation of pure water is taking place from the enormous surface of the ocean by the solar heat; clouds are formed, which drift in part over the continents, and on coming into contact with the necessary climatic conditions fall as rain; this in its turn filters drop by drop through the soil and forms the springs which overflow and produce the rivers and streams. The water of the latter, however, is no longer pure, but is found on analysis to contain on an average about 0·7 grain of chlorine per gallon,* derived no doubt from the soil, and probably in most cases in combination with sodium. The water thus charged with chlorides reaches the sea, where it is subjected to the concentrating process described above, and so time after time the soil is lixiviated, the chlorides dissolved out of it accumulating in the ocean.

The above theory only requires to be stated to commend itself at once as the most probable and natural explanation of the saltness of the sea, however the latter may be augmented in certain regions by the discharge of brine-springs. But it must be remembered that chlorides are not the only solid contents of spring and river water: for every grain of chlorine present in them, we find on an average from 6 to 8 grains of carbonate of lime; what, then, is the destination of this latter constituent? Clearly, as soon as the carbonic acid, which alone renders it soluble, is dissipated by the sun's heat at the surface of the sea, it will subside in fine particles to the bottom, there forming a "fur" similar to, but less consistent, than the deposit which causes constant annoyance in our steam boilers, and even in the domestic tea-kettle similar to the latter, for its origin and chemical character are the same, but differing in consistence on account of the far more gradual and gentle manner in which it is separated,

* It should be mentioned that *natural* water is here referred to, the writer found 0·8 grain of chlorine in the water of a spring situated in a remote part of the Welsh hills.

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which causes it to appear as the fine mud or "ooze" described as coating the lower half of the recovered Atlantic cable.

It is not, of course, denied that the sediment thus produced is largely supplemented by the chalky exuviæ of marine animal life, or that the deposit may not in parts even mainly consist of the latter, but it is maintained that the greater portion of the amorphous "ooze," and of the chalk, which appears now to be identified with it, must necessarily be the product of a purely chemical process of the kind described; otherwise we are at a loss to account for the disposal of the enormous weights of carbonate of lime carried daily into the sea by the rivers.

ON A NEW PROCESS FOR THE ESTIMATION OF IODINE IN KELP LIQUORS, MINERAL WATERS, &c.

By E. SONSTADT.

THE addition of an alkaline permanganate to a liquid containing an iodide in solution, converts the iodide into an iodate, provided sufficient free alkali, or alkaline carbonate is present to prevent liberation of iodine. This fact (which I discovered early in the present year, in the course of investigations having for their object the effecting of improvements in the manufacture of iodate of potassium direct from the mother-liquors of kelp, instead of from iodine, as hitherto practised), I have found very serviceable for the estimation of iodine.

Alkaline solutions of chlorides and bromides are not in the least acted upon by permanganate solution. But neither chlorides, bromides, nor any other salts that ordinarily occur with iodides, interfere with the transformation of iodide into iodate by permanganate. Even organic matter does not interfere, provided the permanganate is added in sufficient excess. The process I adopt consists simply in adding excess of permanganate of potassium to the solution of salts containing iodide, until a slight permanent tint of permanganate colouration remains. The solution is first rendered alkaline, best by addition of caustic soda, to an extent adjusted to the proportion of iodide present; but always so far as to preclude any possibility of the liberation of iodine. The liquid is then filtered, and if it does not already contain a sulphate, a small proportion of a sulphate is added to it. Solution of chloride of barium in excess—but not in much excess—is then added, and the precipitate, after separation from the liquid by filtration and washing, is heated with solution of sulphate of potassium in excess. The filtered solution contains the whole of the iodine originally present in the portion taken for analysis, as iodate of potassium. The quantity of iodic acid may be estimated volumetrically by any of the usual processes; or the mixture of iodate and sulphate may be ignited at a low red heat, and the iodide of potassium remaining be estimated either volumetrically or gravimetrically.

In this process, the transformation of iodide into iodate by permanganate in alkaline solution is *complete*. The precipitation of the iodic acid by a barium salt in presence of a sulphate is *complete*. The decomposition of iodate of barium by heating with solution of sulphate of potassium in excess, is *complete*. By the word "complete," I mean within appreciable limits. That is to say, I have, in the course of many experiments specially devoted to that end, been unable with certainty to detect even a trace of iodine either in a liquid in which an iodide had been transformed into iodate as described, and precipitated, in presence of a sulphate, by chloride of barium; or in the barium precipitate, after heating with sulphate of potassium in excess, filtering, and duly washing.

The severest test that can be applied to a process of this kind, is not to use it upon weighed quantities of an iodide, but to try it upon liquids containing, for the quantity taken, imponderable quantities of an iodide or of an iodate. The experiments that have already been described on sea-water, in my paper "On the Presence of Iodate of Calcium in Sea-water," afford a good illustration. In these experiments, one part of iodate of calcium in a quarter million parts of liquid, sufficed, in such a quantity of the liquid as did not contain a ponderable quantity of iodine, to give measurable iodine reactions in the precipitate thrown down by chloride of barium. And yet, if we suppose the whole of the iodine in sea-water to exist as iodate of barium, after addition of a barium salt, the sea-water would contain only about 1 per cent of a saturated solution of that salt. I at first supposed this very complete precipitation of iodic acid by barium salt in sea-water to be owing to some element contained in my chloride of barium, that formed an iodate much less soluble than any that had been described. I therefore took a considerable quantity of the same chloride of barium that had been used in these experiments, and precipitated it fractionally by solution of pure iodate of potassium at three times. All the precipitates had sensibly the same degree of solubility in water. Iodate of barium is remarkable, however, in this; that it dissolves with such extreme slowness in even boiling water, that it is the work of days with the aid of heat, to get a really saturated solution. The water used in these experiments had been carefully distilled off permanganate of potassium, since water not perfectly free from organic matter cannot be trusted for solubility determinations of the iodates. The results I obtained agreed nearly enough with the published determinations of the solubility of iodate of barium to convince me that the complete precipitation of iodic acid in presence of sulphuric acid by a barium salt, is due to surface attraction, between sulphate of barium formed in the liquid, and nascent iodate of barium. If we consider how many square metres of surface a single gramme of so finely divided a precipitate as sulphate of barium usually is must present, the property that this salt is supposed to enjoy above all others, of carrying down with it other more soluble salts, ceases to appear inexplicable. Yet this power certainly is not exercised solely in obedience to the degree of solubility of the salt so pulled, by mechanical attraction, as it were, out of solution. A *colloid* salt and a *crystalloid* salt seem to have no pulling power upon one another; and crystalline salts apparently are subject to such influence under some law connected with the complexity of their crystalline form. Again, two colloid salts, as the hydrates of alumina and of ferric oxide, scarcely admit of complete separation.

FLUORESCENCE.

IN a series of papers to *Poggendorff's Annalen*, Herr Hagenbach describes extensive researches on this subject. We propose here to give a brief statement of his results.

To the question whether all the rays of the spectrum are capable of exciting fluorescence, he considers an affirmative answer may be given. As to excepting the red rays before B, from which fluorescence was not obtained, it is to be considered, that since fluorescent light is always less refrangible than the exciting light, fluorescence excited by the extreme red may not be visible by our eyes.

As to the extent of fluorescence in the spectrum, there are cases (as that of fluor-spar), in which it only begins in the violet after G; and others (as chlorophyll) in which it is spread over the entire spectrum. No fluorescent substance was met with which did not fluoresce in the neighbourhood of the line H.

The maxima of the fluorescence were very various,

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From 7 maxima, *e.g.* in chlorophyll solution, to 1 maximum (so to call it) in ether and sulphuric acid. In some cases the difference between maxima and minima was very perceptible, in others not.

Stokes's law, that where rays excite fluorescence a corresponding absorption takes place, was verified. The absorption spectrum could thus frequently serve to determine more accurately the maxima of fluorescence. But it is frequently found that absorption of light occurs without corresponding fluorescence. Herr Hagenbach observed, *e.g.*, in a water solution of litmus an absorption additional to that corresponding to the fluorescence. This is probably explained, he thinks, by the mixture of a fluorescent with a non-fluorescent substance.

As to the spectrum of fluorescent light, there is also great variety in this. The spectrum with least extent was that of chlorophyll; while those of fluor-spar and miomelanic acid were among the most extended. With regard to "intermittence" in the light intensity, we have various cases. From 8 maxima in nitrate of urea, 6 in bichloride of anthracene and petroleum, down to 1 maximum, and so no intermittence, in naphthalene, red nitrate of chrysanilin, and others. The difference of brightness between maxima and minima is, as in the former case, well marked in some substances, and in others not.

Is there any correspondence between the intermittence in the fluorescence of the spectrum (the fluorescent spectrum) and that in the fluorescence spectrum? In some cases there appeared to be such, as *e.g.* in extract of soot, which gave 5 maxima in both spectra. But other cases showed there is no necessary connexion between the two. Thus the solution of fresh chlorophyll gave 7 maxima in one spectrum and only 2 in the other. Naphthalene showed 3 maxima in one spectrum, and no intermittence at all in the other. Nitrate of uran, giving 8 maxima in the fluorescence spectrum, gave no intermittence in the ordinary spectrum.

Is the intermittence of fluorescence in the one case or the other to be explained by mixture of fluorescent substances? This is Von Pierre's hypothesis. While it is possible to produce intermittence artificially through mixture, Herr Hagenbach considers that in many instances the hypothesis is improbable. Then in the case of a fresh solution of chlorophyll giving intermittence (which, it is said, arises from the mixture of various different materials), it would at least be a singular thing that in all kinds of plants containing chlorophyll, the materials were mixed in like proportions, and that all the materials which by the different rays were excited to fluorescence should give the same fluorescence spectrum.

Stokes's law that in fluorescence light the rays called forth are never more refrangible than the exciting rays, was found in every instance to hold good.

Herr Hagenbach also verified Von Pierre's propositions as to the connexion between the exciting and the excited rays.

With reference to the influence of the solvent on the character of the fluorescence, it was found, in many cases, that do change in effect arose from changing the solvent; in other cases, the maxima of the fluorescence or of the fluorescence spectrum, were displaced. Several instances are given. Thus in ether solution of amide of phthalic acid, the beginning and maximum of fluorescence are nearer the violet end than in the alcohol solution. The same thing is found in similar solutions of chlorophyll.

Kraus made the observation, that the thicker a solution is, the further are absorption-bands moved towards the red end of the spectrum. As fluorescence maxima and absorption-bands correspond, Herr Hagenbach considers his experiments may serve to confirm Kraus's view; but that the data as to the relation between fluorescence and absorption are as yet somewhat insufficient. Cases of displacement (through change of solvent) in the fluorescence spectrum are further given; and the author asks whether a displacement of the maxima of fluorescence is always accompanied by a displacement in the fluorescence spectrum. In the ether and alcohol solutions of amide of phthalic acid, the ether and alum solutions of purpurin, and other instances, this was found to take place; but in others, as a solution of extract of soot with oil of turpentine, compared with a solution of the same substance in ether or alcohol, it did not.

The question whether fluorescence in the solid state implies fluorescence in a state of solution, and *vice versa*, must be answered differently for different substances.

Some substances fluoresce in the solid state, and not at all in solution; some greatly in the one state, little in the other; some show strong fluorescence in both states; some fluoresce little in the solid state, and greatly in solution; some fluoresce only in solution.

Herr Hagenbach considers it probable that phosphorescence and fluorescence are phenomena differing in degree only, not in kind; though further data are necessary to the elucidation of this. He finds much similarity between the fluorescence spectra and many of the spectra of phosphorescent substances.

A. B. M.

ON THE CONCENTRATION OF SULPHURIC ACID.

By R. HASENCLEVER.

It is well known that the sulphuric acid prepared in the leaden chambers is first concentrated up to a sp. gr. of 2·7 in leaden apparatus; while the further concentration to 66° Baumé (sp. gr. 1·85) is carried on in vessels made of glass or platinum. All the leaden apparatus used for the purpose of concentrating the chamber acid to 60° Baumé (sp. gr. 1·7), are more or less acted upon by the acid; and it is of great importance to be well acquainted with the behaviour of the lead with acid at different temperatures. Experiments made in the chemical laboratory of the Chemical Works, Rhenania, proved that when pure sulphuric acid was evaporated in a vessel made of doubly refined lead, sulphurous acid was given off at a temperature of 165° to 178°, and at a degree of concentration of the acid at 57° Baumé (1·659 sp. gr.), there was a distinct smell of sulphuretted hydrogen. While at 180°, and with an acid at 58° Baumé (1·678 sp. gr.), a very strong decomposition of the acid, attended by violent foaming and deposition of sulphur, commenced. The same phenomena have been observed on the large scale; by the overheating of the sulphuric acid so much gas was suddenly evolved that the liquid contained in the leaden pan boiled violently, while sulphurous and hydrosulphuric acid, as well as sulphur, were set free simultaneously. Sulphuret of arsenic was formed in acid contaminated with arsenic.

It has often been thought that these phenomena were due to impurity of the lead, and that metal was frequently analysed by the sulphuric acid makers, as well as by lead merchants, who were blamed for the corrosion of the leaden pans; but it appears that only trifling impurities were detected in the lead. At the chemical works above named it became customary to use a thermometer, and by that means the corrosion of the leaden pans due to overheating of the acid was prevented. Some few weeks ago, however, a brisk evolution of gas was observed in one of the leaden pans, while the acid contained therein was only at a temperature of 135°. The gas evolved was found to be hydrogen, while the lead of which the pan was made was moderately pure. Since it was known to me that the complaints of the rapid corrosion of the leaden pans have increased since the lead is de-silvered with zinc, it occurred to me that a pure soft lead obtained according to the new method, would be more apt to become corroded. I procured a sample of Mechernich lead (a locality in

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Prussia where lead ore is largely smelted), the composition of which was percentically—Lead, 99·9941; silver, 0·0006; copper, 0·0008; antimony, 0·004; iron, 0·0005. This lead was put into a flask, and pure sulphuric acid of 54° Baumé (sp. gr. 1·601) poured over it. On being heated to 40°, small gas bubbles were seen to be emitted from the lead, and at 80° a distinct and continuous, though not a brisk, evolution of gas took place, which increased with an increase of temperature. The gases evolved were hydrogen and sulphuretted hydrogen. A portion of this same sample of lead was molten and mixed with some antimony, and after cooling, the sample was again submitted to the same treatment with pure sulphuric acid at 54° Baumé. A very faint evolution of gas commenced when the acid was heated up to 85°, and even at 100° this evolution of gas was hardly stronger, but at 140° the evolution of the gases became rather more brisk.

From the results of a series of experiments I am inclined to believe that pure and soft lead does not resist the action of hot sulphuric acid so well as the harder kinds of lead; a fact which is of practical bearing and deserves to be further studied by experiments. As regards the apparatus more commonly in use for concentrating sulphuric acid (chamber acid) these are—

(1). Evaporating pans made of sheet-lead placed on plates of cast-iron, below which the fire is kindled (direct heating).
(2). Leaden pans heated by means of a reverberatory furnace (the flame playing over the surface of the acid), the edges of the leaden pans being hollow and filled with cold water in order to prevent the melting of the lead.
(3). Concentration by means of high-pressure steam.
(4). Concentration by means of heated sulphurous acid gas.

As regards the first mentioned apparatus, it is absolutely necessary to control the evaporation by means of a thermometer in order to prevent the overheating of the acid, and consequently the corrosion of the lead. When the workman in charge of the operation of evaporating takes due care, and makes frequent use of the thermometer, these leaden pans may last a long time, although they will require frequent repairs, and are not to be recommended for economy in the consumption of fuel and loss of acid. The reverberatory furnace for evaporating acid is an English invention, and has been introduced into Germany some few years since at Lüneburg. These furnaces do not consume much fuel, require little repair, but their use is attended with the inconvenience that the acid becomes readily overheated; while with the smoke and other products of the combustion, much sulphuric acid is carried off. On this account the use of this apparatus has been discontinued in many works. The first suggestion of the application of indirect high-pressure steam to concentrate sulphuric acid (chamber acid) has been made by Carlier, the technical manager of the Chemical Works of F. Curtius, at Duisburg (Rhenish-Prussia). After a series of preliminary trials, the chamber acid, at the works just mentioned, is now evaporated in the following manner:—The acid is poured into a wooden lead-lined tank 4 metres in length and width. On the bottom of this tank are placed two coils of leaden pipes 45 metres long, 0·03 metre internal diameter, and 0·007 metre thickness of lead. Through these coils high pressure steam is forced as long as the tank is filled with acid. In order to cause the water of condensation in the tubes to run off freely, the bottom of the tank is made in the shape of a cut-down pyramid: the depth of the tank in the centre being 0·60 metre, and at the sides 0·30 metre. The ends of the tubes (outlet and inlet) communicate with a steam boiler placed at a lower level than the tank, stopcocks being fitted to the inlet and outlet of the leaden pipes (coil). The inlet of the coil communicates with the steam-boiler below the water-level therein; while the outlet of the coil communicates with the steam-chest, thus affording an opportunity for the condensed water to flow back into the boiler.

The operation of concentrating the chamber acid is intermittent. The tank having been filled with acid at 1·5 sp. gr., the circulation of steam is kept up until the sp. gr. of the acid has increased to 1·7; this point having been reached, the hot acid is transferred to a wooden lead-lined tank, at the bottom of which is placed a serpentine coil of leaden pipes through which the chamber acid is made to pass before flowing into the concentration tank, so that the latter is filled with acid which is already warm.

In an apparatus of the size and dimensions alluded to, 5 tons of chamber acid are concentrated to 1·7 sp. gr. in 24 hours. The steam in the boiler is at a pressure of 3 atmospheres (= 45 lbs. to the square inch = 135·1° temperature); the quantity of fuel consumed amounts to 9 per cent of the acid concentrated. As regards the feeding of the boiler, this need only be intermittently done by the aid of a force-pump (donkey engine with pump), because the regular supply of water is derived from the condensed steam. It is advisable to construct at a short distance from the top of the tank a wooden hood, so that in the event of any part of the leaden coil placed at the bottom of the concentration tank bursting, the hot acid while being thrown about does no injury.

This method of concentrating chamber acid is in every respect superior to the other plans. The lower temperature prevents volatilisation of acid, which is also not contaminated with soot, dust of ash, and smoke, while the expense is, lastly, considerably less. In many parts of Germany this method of concentrating chamber acid has been introduced.

The hot gases of the pyrites burners are often applied for the purpose of concentrating chamber acid. Sometimes leaden pans are placed on the top of the kilns; or, again, the hot sulphurous acid gas is conveyed into a leaden tower lined with bricks. As regards the placing of leaden pans on the top of the pyrites kilns, this plan is attended with inconvenience, for if the pans become leaky, the whole process of sulphuric acid making has to be suspended, while the acid finding its way into the pyrites burners destroys them. It is therefore better to place the concentration pan on a channel situated between the sulphuric acid chambers and the kilns; so that the manufacture of acid is not discontinued when repairs to the leaden pans are required.

A more perfect and greatly improved application of the hot sulphurous acid gas issuing from the pyrites kilns is made in the so-called Glover's towers, a contrivance frequently employed in England, and fully described in the second number of *Dingler's Polytechnisches Journal* for August, 1871, by Lunge. By the direct action of the heated kiln gases upon the sulphuric acid, evaporation ensues; the sulphurous acid gas is strongly cooled down before it enters the leaden chambers; the sulphuric acid and steam which are volatilised also enter the chambers, so that no loss of acid ensues; while, at the same time, the steam supply to the leaden chambers can be diminished. The sulphuric acid obtained by this method of concentrating chamber acid is not quite free from sulphurous acid, a point to be taken into consideration for certain applications of the acid, in which I found 0·7 grm. of SO_2 to the litre. It should be further mentioned that, when the Glover system is applied, there cannot be simultaneously applied a contrivance to arrest the dust and small particles of partly burnt pyrites carried off along with the sulphurous acid, because by the application of such contrivance the sulphurous acid gas would be too much cooled down to be fit for evaporating purposes, and as a consequence the dust would contaminate the acid, rendering it ferruginous. For the purposes, however, of sulphate of soda making, and for dissolving coprolites and other native phosphates, the acid just alluded to is quite pure enough. At my suggestion, a Glover concentration tower has been constructed at the Hautmont

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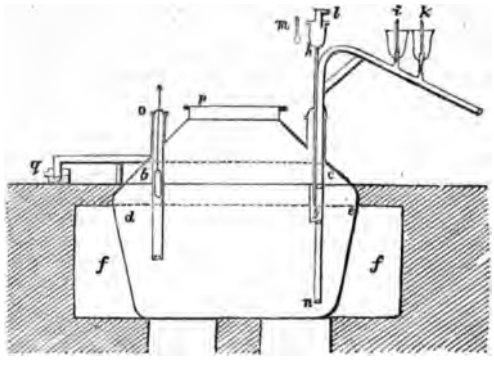
Chemical Works; the results obtained by working it are very satisfactory, and the quantity of iron in the acid only amounts to 0·05 per cent.

As regards the further concentration of the sulphuric acid at 1·7 to 1·85, this is now generally effected in Germany in platinum vessels, the price of which has been brought down to from £48 to £30 per kilo. The construction and mode of operating with platinum vessels is well enough known, but I give here the description of a syphon apparatus which has been made according to my instructions by Messrs. Demontis and Quenessen, at Paris. The mode of construction of this syphon may be inferred by inspection of the woodcut; the contrivance is arranged to prevent the acid in the platinum vessel sinking below a certain level. This arrangement of the syphon apparatus would not be needed if the workman in charge of the concentration operation would pay proper attention to the position of the float; but in actual practice this is not always done, and hence it happens that more acid is withdrawn by the syphon than flows into the platinum still, so that the level of the acid in the same sinks below the line *d e*; in that case, the platinum becomes, or is liable to become, over-heated by the direct action of the heat in the flue, *f*, and as a consequence the metal becomes cracked, especially if, while red-hot, it is brought into



contact with cold acid carelessly poured or admitted into the still. In order to prevent this inconvenience, there has been fitted to the syphon a small tube, *g h*, the lower opening of which reaches just to the lowest admissible level of the acid in the still. When the level of the fluid in the still is above *d e*, the opening, *g*, is closed, and the syphon acts in the usual manner; but, as soon as the level of the acid sinks below *d e*, the syphon sucks air at *g*, and the further action of it is at once stopped. By this contrivance, the possibility of withdrawing from the platinum still so much acid as to expose the metal of the still to the fierceness of the heat of the flue is presented; and, in order to make the syphon act again (of course, after sufficient acid has been run into the still, and been sufficiently concentrated), the workman has to pour strong acid into the cups *i* or *k*. In case it might be necessary to completely empty the still, the lid, *l*, is taken off, the plug, *m*, is put into *h*; after which, by means of the syphon, the acid may be withdrawn from the still as far as *n* (that is to say, a few millimetres' distance from the bottom). If, by carelessness, the workman should run into the still more acid than is carried off by the syphon, the liquid would run over at *o* and *p*; but, by means of the contrivance *q* (an overflow pipe), this may be prevented, and by the arrangements alluded to it becomes possible to keep the level of the acid in the still within proper limits [illegible] apparatus almost automatically.

[illegible] corresponding to degrees Baumé, Dr. O. A. Ziurek's work, "Tech[illegible]tician.—*Ber. d. Deutsch. Chem.*

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Annual Meeting, April 30th, 1872.

E. W. Binney, F.R.S., F.G.S., President, in the Chair.

The Report of the Council was read by one of the Secretaries.

The following gentlemen were elected Officers of the Society and Members of Council for the ensuing year:—

President—James Prescott Joule, D.C.L., LL.D., F.R.S., F.C.S., &c.

Vice-Presidents—Edward William Binney, F.R.S., F.G.S.; Edward Schunck, Ph.D., F.R.S., F.C.S.; Robert Angus Smith, Ph.D., F.R.S., F.C.S., &c.; Rev. William Gaskell, M.A.

Secretaries—Henry Enfield Roscoe, B.A., Ph.D., F.R.S., F.C.S., &c.; Joseph Baxendell, F.R.A.S.

Treasurer—Thomas Carrick.

Librarian—Charles Bailey.

Other Members of the Council—Peter Spence, F.C.S., M.S.A.; Henry Wilde; Robert Dukinfield Darbishire, B.A., F.G.S.; Osborne Reynolds, M.A.; William Boyd Dawkins, M.A., F.R.S., F.G.S.; Balfour Stewart, LL.D., F.R.S.

"*On Arsenic from Alkali Works*," by H. A. Smith, F.C.S. Communicated by Prof. H. E. Roscoe, F.R.S.

Some time ago the author laid before the Society the results of several analyses of the amounts of arsenic contained in different species of pyrites, and in several of the products in the manufacture of which the acid was employed. At that time he carried his analyses as far as the carbonate of soda, in which no arsenic was found. The present paper is supplementary to the former, and he now endeavours to show that not only does the arsenic remain in the various products of alkali manufacture, but even escapes to the atmosphere.

When the salt used for the production of hydrochloric acid is treated with sulphuric acid, containing arsenic, the arsenic present becomes converted into the trichloride. This compound is said to be completely decomposed by contact with water, so that, after passing along with hydrochloric acid gas through the condensing towers, it would scarcely be expected that any traces of the arsenic originally present would be found in the escaping gas. The author finds this, however, to be the case. A considerable quantity of the arsenic trichloride escapes the action of the water in the condensing towers, and passes, along with a very small proportion of the hydrochloric acid gas, to the chimney.

A deposit found in the flue, about 20 feet long, leading from the salt-cake furnace to the condensing towers, the coke contained in the towers themselves, the gas in the flue leading to the chimney, and the smoke escaping to the chimney, were all submitted to analysis, and were all found to contain arsenic.

The results are gathered together in the following tables:—

Table I.

Deposit in Flue leading from Salt-Cake Furnace to Condensing Tower.

	Arsenic Trioxide per cent.
Mean of 9 analyses	=43·434

The total numbers in this case were found to agree very closely, varying only from 39 per cent to 47·7 per cent. This flue had been working for some years.

Table II.

Coke from Condensing Towers.

	Arsenic Trioxide per cent.
Mean of 3 analyses	=2·886

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In this case 10 lbs. of coke was used for each analysis, and was digested well, first with distilled water, and then with pure hydrochloric acid. The towers had been in use for about a year.

TABLE III.

Air in Flue leading from Condensing Tower to Chimney.

Amount of air taken for each analysis = 500 cubic feet.
Amount of air passing = 31·722 cubic feet per hour.
The mean of 12 analyses is here given.

Arsenic Trioxide per 1000 cubic feet.	Arsenic Trioxide per hour.	Arsenic Trioxide per day.
Grains.	Grains.	Grains.
0·158	5·012	115·134

The arsenic will probably escape either as arsenious acid or as arsenic trichloride. If as the latter, it may be decomposed, on coming in contact with the atmospheric moisture, into arsenious and hydrochloric acid—

$$(2AsCl_3+3H_2O=As_2O_3+6HCl).$$

TABLE IV.

Specimens of Air, taken 10 feet from Bottom of Chimney.

Amount of air taken for each analysis = 500 cubic feet.

	Arsenic Trioxide per 1000 cubic feet.
Mean of 9 analyses	= 0·086

The author did not know the amount of air passing in the chimney, so he only calculated the amount of arsenic trioxide in grains per 1000 cubic feet.

The method employed for collecting the arsenic trioxide contained in the last two tables was very simple. The air was drawn through three bottles, containing respectively water, hydrochloric acid, and nitrate of silver. The gas was allowed to bubble very slowly through the solutions. The bottles containing them were capable of holding 40 ounces, and were filled about half full.

The idea of arsenic being present in the atmosphere surrounding chemical works is by no means new. The fact of its existence in large amounts in the ore from which the greater proportion of our vitriol is made leads one to suppose that it must find its way into the atmosphere at one place or another, but the author believes that this is the first time the comparative amounts have been brought forward.

"*On Animal Life in Water containing Free Acids*," by H. A. SMITH, F.C.S. Communicated by Prof. ROSCOE, F.R.S.

At a time when so much is being written concerning animal life, its origin, and the conditions under which it can exist, it was thought it might be interesting to find out to what extent it was influenced by the presence of free acid in the water in which it existed, and also to see to what extent free acid prevented its origination.

The animals upon which the experiments were tried were the rotifers (*Rotifer vulgaris*).

A certain amount of air was washed with distilled water, and life allowed to originate in the solution, so that it could be seen at once what influence the amount of acid usually found in air had upon the life.

As a rule it required five days to bring the rotifers to perfection. The method of experiment was very simple. After animal life had been procured in the solution, a known amount of the various acids used was then added, and allowed to stand one day: this was repeated till enough had been added to destroy life.

The results of these experiments are embodied in the following tables:—

TABLE I.

Sulphuric Acid added.

Time allowed to stand.	Total Acidity.	Remarks.
Days.	Grms. per Litre.	
5	0·065	Animal life very abundant. Rotifers in very active condition.
6	0·084	No perceptible difference in appearance of life.
7	0·097	Brownish shade evident in water. Want of clearness in portion examined. Small "clots" of vegetable matter visible. Rotifers languid, seemingly disinclined to move.
8	0·153	Life continued for about an hour; all traces then disappeared. The water presented the appearance of being filled with decomposing and decaying organic matter, which was floating about in "shreds."

TABLE II.

Hydrochloric Acid added.

Time allowed to stand.	Total Acidity.	Remarks.
Days.	Grms. per Litre.	
5	0·0085	Same as in Table I.
6	0·0109	No perceptible difference in the appearance of solution.
7	0·0180	No difference observable.
8	0·0190	Life almost immediately extinct. Fluid still clear. Bodies of rotifers seen floating in it, but of a dull opal-like colour, and being rapidly acted upon by the acid, seemingly becoming "shredded."

TABLE III.

Sulphurous Acid added.

Time allowed to stand.	Total Acidity.	Remarks.
Days.	Grms. per Litre.	
5	—	Life very abundant.
6	0·002	Rotifers more active, causing great disturbance in liquid.
7	0·004	Life sluggish. Rotifers not inclined to move.
8	0·010	After 3 hours all life extinct. No obvious action on the bodies of animals.

It is very interesting to compare these three tables. The order of deleterious influence on animal life being first sulphuric, then hydrochloric, and sulphurous acids in order, the action of the two latter being much more distinctly marked than the action of the former.

In making observations on the amount of free acid required to prevent origination of life, it is found that the order of acid is the same as above, but that the line is much more sharply drawn.

TABLE IV.

Experiments on the Amount of Free Acid contained in Water in which Animal Life can originate.—Sulphuric Acid added.

Time allowed to stand.	Total Acidity.	Remarks.
Days.	Grms. per Litre.	
8	0·070	Life abundant.
20	0·074	Little or no life.
26	0·080	No life.

TABLE V.

Hydrochloric Acid added.

Time allowed to stand.	Total Acidity.	Remarks.
Days.	Grms. per Litre.	
5	0·0085	Life abundant.
8	0·0090	No life.

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Water acidified with 0·0025 grm. sulphurous acid per litre was allowed to stand exactly under the same conditions as the former, to see if life could originate in water containing that amount of acidity, but after standing twenty-one days no life was visible.

It is interesting to notice, in these last two tables and the remark on sulphurous acid, the sharp line of demarcation between the amount of acid contained in water in which life can originate and that which totally prevents origination.

In the case of sulphuric acid we find that the small amount of 0·010 grm. per litre, in addition to the ordinary acidity, completely prevents it, whilst in the case of hydrochloric acid 0·005 grm. per litre is sufficient. In the case of sulphurous acid the author could not get life to originate in water containing any of that acid.

CORRESPONDENCE.

NEW PROCESSES FOR ANALYSING COMPOUND ETHERS.

To the Editor of the Chemical News.

SIR,—Dr. Dupré's letter of last week calls for reply. I perceive that he does not lay claim to the method of dealing with fats by means of an application of Erlenmeyer's process with hydriodic acid, whereby iodide of isopropyl is formed; but that he claims to have described the process of decomposing the ethers with alkali, and subsequently estimating the alcohol set free. This he claims to have done in his paper on Wines, published in the year 1867.

I think most chemists will agree with me that in the year 1867, as at the present time, there could be no originality in the abstract statement that compound ethers admit of having the alcohol, which they yield to alkalies, measured or weighed. Doubtless original papers by chemists contain such a statement, and most probably it has been made in chemical lectures, and even in answers by students to examination papers. In 1867, as at present, all that was open to a chemist was to *remind* his brethren of the abstract possibility of such a process, and to point out how to do it and the advantages of resorting to it. Among these advantages I maintain that it is eminently practicable, and capable of yielding very accurate results. As I said in Brighton, I believe that in point of accuracy it will rank with the very best chemical determinations. Notoriously it is not in general use among chemists who are engaged in researches to which it is applicable, and my object in bringing it forward was to induce chemists to use it.

I hope Dr. Dupré will not be offended at being told that, whatever the merits of his paper on wines may be, it has neither induced chemists to adopt the process in question nor was it calculated to do so. Curiously enough, the volatile ethers in wine do not admit of determination by this process. A volatile ether, mixed with several hundred times its weight of alcohol, as occurs in wine, is not under suitable conditions for a determination of the alcohol furnished by decomposing it with alkali; and chemists trying to make such a determination would find themselves exposed to the risk of having the error of experiment greater than the total quantity to be determined. (Unfortunately the evil precedent of a very distinguished chemist has rendered abortive analyses of this description not altogether unfamiliar in England).

In Dr. Dupré's paper I find that he determined the acid of volatile ethers by the usual process, but not a single instance of his having determined the alcohol of a volatile ether; neither can I find any directions for making such determinations, and I will add that it is creditable to Dr. Dupré that he has given none. The non-volatile ethers in wine Dr. Dupré has indeed analysed by measurement of the alcohol, instead of by the usual process of measuring the acid; but, curiously enough, his experiments on the non-volatile ethers of wine illustrate not the ease and accuracy of the method in question, but the difficulties with which it is beset in exceptional cases. He tells us that the alcohol was too weak to be submitted to the ordinary method of measurement by its specific gravity, and that he had to resort to titrations founded on the method of limited oxidation.

If, when I read my paper in Brighton, I had made a reference to Dr. Dupré's work on Wine, it would have been proper for me to have told the chemical section that—notwithstanding the circumstance that the volatile ethers in wine do not admit of being dealt with by the new process, and notwithstanding the difficulties which Dr. Dupré had found in dealing with the fixed ethers in wine by the precess—still, under ordinary circumstances, it is practicable, easy, and accurate, not only in the instance of the fixed ethers, but also of the volatile ethers.—I am, &c.,

J. ALFRED WANKLYN.

RED COLOUR SOMETIMES OBSERVED IN WHITE-LEAD.

To the Editor of the Chemical News.

SIR,—In your "Chemical Notices from Foreign Sources" (vol. xxvi., p. 35), you quoted with well-deserved commendation the results of the labours of Messrs. A. Bannow and G. Krämer upon the red colouration sometimes observed in white-lead. Having procured the original communication and carefully considered the experiments these gentlemen have made, although admiring the industry and ability displayed, I must entirely dissent from their conclusions. I also regret that my contribution to the *Philosophical Magazine* in May, 1869, upon this subject appears to have escaped their notice.

My results, which were procured with all the advantages of experiments in a large manufactory, led most decidedly to the conclusion that silver in certain quantities, commencing at about 0·002 per cent, imparts a uniform pink colour to white-lead corrosions. This conclusion accords completely with practical results, and its truth may be readily tested. Provided the sample of commercial soft lead is free from antimony, and that it contains 0·005 per cent of silver, the corrosion will certainly be pink. The depth of the colour is influenced by the character of the corrosion. In a hard flaky corrosion the colour is worse; where the corrosion is swelled and soft the tint is naturally less, owing to the fine particles of silver being spread over a larger surface.

I have made synthetic experiments as follows:—A sample of lead which had repeatedly produced good white corrosions was melted, and a small portion of pure silver added. On submitting these samples to the corroding action in the stacks, only red-tinted corrosions could be obtained, no matter in what position of the stacks they were placed. The addition of antimony again will produce a dull purple-coloured corrosion; but, upon re-oxidising the antimony, the next corrosion will reproduce the pink colour.

Of the samples of lead submitted to experiment by Messrs. Bannow and Krämer, only No. 5, in my estimation, has sufficient silver to produce the tint in a marked degree; but traces of the colour may be often observed close to the core of uncorroded lead, when the bulk of the corrosion is of a fair white colour.

I ought to add that for some time I was convinced this red colour was due to cuprous oxide, and, indeed, I published this opinion in 1862. Subsequently, after refining a large quantity of lead by the zinc process, I had at command a quantity of lead containing only a trace of copper and other metals, but still retaining about 0·005

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per cent of silver. I found I could obtain with this lead nothing but pink-coloured white-lead.—I am, &c.,

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CONSTITUTION OF MATTER.

To the Editor of the Chemical News.

SIR,—Without commenting upon Mr. Kingzett's paper, permit me to draw his attention to two points, the inaccuracy of which does not strengthen his illustrations respecting the atomic and molecular influence exerted by the various cosmic forces. The radical methyl is not CH_3, but is C_2H_6. There is no proof whatever that methyl and ethyl hydride are not identical bodies. Their reactions are identical; their specific gravity, solubility, &c., are practically identical, and they yield the same dichlor. substitution product. Their mode of formation is sometimes in favour of the one view, sometimes of the other. Schlorlemmer's experiments offer proof in the same direction.

It is therefore not correct to say, that "from the radical methyl we can produce its compounds, but we cannot produce them from ethyl hydride."

Again, propylic alcohol has *not* the same composition, and is *not* isomeric with acetone: it is not surprising, therefore, that they should possess dissimilar properties. —I am, &c.,

J. W.

CONSTITUTION OF MATTER.

To the Editor of the Chemical News.

SIR,—In his paper on the "Constitution of Matter" (CHEMICAL NEWS, vol. xxvi., p. 138), Mr. Kingzett says—"If by some operations a certain substance had its properties changed, the question arises, Should it still be regarded as the original substance?" Mr. Kingzett thinks not. What a glorious chance would this afford to amateur chemists who wish to distinguish themselves by the discovery of new substances! Let them take a beaker of pure water at about 0° C., and heat it gradually to 100°, marking down in their note-book the discovery of a new substance for every intermediate degree.

"That many simple bodies have properties very much like those of each other," as exemplified by bromine, chlorine, and iodine, is no proof of the mono-elemental theory of matter, but (observing the relations between the gradation of properties and the gradation of atomic weights) is strongly in support of the atomic theory, which stands opposed to the theory advocated by Mr. Kingzett.

"See," says Mr. K., "how the metallic bodies fade into the non-metallic bodies, and animal into vegetable life." Such an abstract idea as this is of no use in a discussion on physical or chemical science, its relation to the subject being too ill-defined to serve as the basis of a thought.

Mr. Kingzett advances the idea that "all the simple known and unknown substances . . . are composed of the same, and only elemental matter, each being differently acted upon by natural molecular forces." We have no doubt that the only difference between the so-called elements (hydrogen, oxygen, &c.) is the difference of their respective atomic weights, and *of course* corresponding atomic sizes. And, if this is the case, the ultimate atoms themselves (whether of hydrogen, oxygen, or of any other element) must be all of the same, and only elemental matter, because, not being themselves composed of atoms, no difference in the nature of their substance can exist. Thus far we agree with the mono-elemental theory.

Mr. K., having this theory firmly fixed in his mind, has, through it, fallen into a great error. He supposes that all the so-called elements, being composed of only one primordial matter, there is no chemical difference between them but which may be reconciled by the withdrawal or alteration of the forces. But, inasmuch as the withdrawal of the forces cannot alter the atomic sizes, the chemical nature of the elemental bodies cannot thus be altered.

"On this view of the matter," says Mr. Kingzett, "a compound would be formed by uniting a force between two or more such differently operated upon portions of elemental matter."

Under this supposition the compound formed from two elements is, to use the Hibernian style of phraseology, as much an element as either of the substances from which it was formed; the only difference consisting, not in the different absolute amount of forces, but in the forces being brought to operate upon the whole combined mass of matter in a mean of the difference in which they existed in the uncombined elements.

But how is it that when this average force is attained it can never be divided to form substances of indefinite atomic proportions? How is it that the mean of force attained never equals the amount of force contained in any of the elements. or never equals the mean attained by the union of other elements?

Your correspondent asks himself the question, "How do you suppose matter to have been operated upon so as to form different kinds?" He replies by saying, "The forces which constitute the causes were created at the same time as matter was." If heat and electricity are what he calls "the forces," what an idea it is on his part to suppose that these imponderables could remain unequally distributed in matter from the time that matter was created! True it is that different substances are known to contain different quantities of latent heat, and that this latent heat is not diffused from one body to another, even when they are placed in contact; but this depends on the *different atomic weights* of the bodies, and is not observed in bodies of the same nature.

Mr. Kingzett thinks that since the forces are capable of transformation, matter must also be; and considers this idea strengthened by the fact that matter and force are inseparable.

This appears to be a confusion of ideas. That matter and force are inseparable in a physical position is no proof that they are inseparable in physical nature.

How splendidly Mr. Kingzett reveals his want of faith in the tenets of his own philosophy! For, says he, "When *iodine* is used *as in potassic iodide* it is under a peculiar force known as chemical affinity which masks the property which it possesses when free." Mr. Kingzett's philosophy requires him to believe that when two elements are united as compounds they are entirely destroyed as elements, and only form another element under a different molecular force. Yet here we have Mr. Kingzett confessing that in potassic iodide the iodine exists in its own nature; but under a peculiar force, which masks the property which it possesses when free!

That the difference between ethylic hydride and the radical methyl is merely one of molecular arrangement is obvious (apparently), but the sphere of organic chemistry is no fit place to look for the grounds of an argument; it being so infantile and so rapidly growing a science, and the causes which regulate organic combinations being buried in such profound obscurity.—I am, &c.,

JOHN F. SUTTON.

MISCELLANEOUS.

Agricultural Instruction.—At Proskau, which is situated in Upper Silesia, Prussian territory, is established an agricultural college on a large scale, in which everything relating to agriculture, horticulture, sylvestriculture, and the rearing of cattle, horses, bees, and poultry is

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practically taught. In addition to several smaller lecture-rooms, there are two large amphitheatres, which will accommodate 200 students each; three separate chemical laboratories; a large distillery; beet-root sugar work; model brewery; museum for mineral and botanical collection; collection of agricultural implements; library containing 6000 volumes; four farms; 5000 hectares of forest land, and 4000 hectares (=2·47 acres to the hectare) of arable meadow land are attached to this institution, in which instruction is given by a staff of twenty-four professors. Proskau is situated very near to the Russian (Poland) frontier, and in the neighbourhood of the town several industrial establishments exist, lime-stone burning and pottery making being very largely represented. The institution alluded to is state property, and has been arranged like the institution known as Hohenheim, near Stutgardt (Wurtemburg). Proskau has 1900 inhabitants, of whom 1500 are Poles.—*Moniteur Scientifique.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, September 30, 1872.

This number contains, in addition to several original papers relating to physics, mathematics, astronomy, and natural history, the following original papers more particularly relating to chemistry:—

Stability of Dyes Fixed on Woven Fabrics in general, and more particularly on Silk.—Professor Chevreul.—This lengthy essay, elucidated by tables exhibiting results of experiments, treats on the stability of dyes imparted to silk, more particularly damasks and fabrics used in furnishing. The blue colours produced by indigo are fast and stable; Prussian blue resists moderately the action of air and light, but not of soap; scarlets and carmines produced by cochineal and lac-dye are fast; the fastest yellows on silk are produced by weld.

Researches on the Anti-Ferment Properties and Physiological Action of Silicate of Soda.—A. Rabuteau and F. Papillon.—After briefly referring to the researches of Prof. Dumas on the action of borax in fermentation (Chemical News, vol. xxvi., p. 82), the authors describe at length a series of experiments made with the view of ascertaining the effect of silicate of soda upon alcoholic fermentation, upon the fermentation of urea, upon lactic fermentation, and upon amygdalic fermentation. It appears that silicate of soda acts in a similar manner to borax, but far more energetically; not only does it prevent fermentation, but it is a strong disinfectant, and its physiological action, when injected in the blood in aqueous solution (1 to 40), is fatal to animal life, while such is not the case with borax under similar conditions.

Report of the Committee Appointed to Investigate the Alteration Produced in Bread, whereby there is Formed in it Oïdium Aurantiacum.—F. Rochard and Ch. Legros.—This memoir treats on the causes of the formation of peculiar cryptogamic plants in bread, and on the precautions to be taken to prevent this injury, which is mainly due to the use of inferior materials, a badly conducted process of preparation, and insufficient baking of the bread. The authors do not consider that the *O. aurantiacum* is injurious to animal life, because rats largely fed with it have not suffered in health; with due precautions, the use of sound materials, and proper methods of preparing and baking bread, this formation may be entirely prevented, but the addition of a larger proportion of salt will not remedy the evil.

Bulletin de l'Academie Royale des Sciences, des Lettres et de Beaux Arts de Belgique, No 8, 1872.

This number contains the following original papers relating to chemistry:—

Researches on Camphors.—E. Dubois.—This paper is the first instalment of a lengthy essay, recording the results of experiments with which the author is still engaged. The object of this investigation is the study of the chemical structure of camphors. This portion treats on the action of pentasulphide of phosphorus upon monobromated camphor, the object being to obtain bromated cymol. At the ordinary temperature pentachloride of phosphorus (first tried by the author) does not act upon monobromated camphor; at 100° there is no apparent action; at a still higher temperature, scarcely any action is noticed. 1 molecule of pentasulphide of camphor and 5 molecules of the monobromated camphor being heated together on a sand-bath, a very tumultuous reaction occurs, and partial carbonisation of the organic matter ensues. The result of this reaction is chiefly crude cymol, which, on being purified, and having been converted into cymol-sulphate of barium, yielded, by elementary analysis, the following percentical composition:—Carbon, 42·63; hydrogen, 4·62; barium, 24·33; sulphur, 11·37; oxygen, 17·04. Formula—

$$C_{20}H_{26}BaS_2O_6.$$

In addition to cymol, there are formed by this reaction small quantities of hydrocarbons of the same series, and an organic sulphydrate soluble in alkalies.

Report on the Thunderstorm during which the Turret of the Railway-Station at Mechelen (Malines) was Struck by Lightning.—A. Fassiaux.—The author, director-general of the railways (State property), post office, and telegraphs of Belgium, gives a detailed account of the curious effects of the striking by lightning of the clock-turret of this large building during a thunderstorm in July last.

Les Mondes, October 3, 1872.

International Congress on the Metric System.—The States represented at this meeting are—The United Kingdom, France, Russia, Germany, Austro-Hungary, Spain, Belgium, the Netherlands, United States, Argentine Republic, Bavaria, Chili, Columbia, Denmark, Republic of Ecuador, Greece, Haïti, Peru, Portugal, San-Salvador, Sweden and Norway, Turkey, Venezuela, Würtemberg, Italy, Nicaragua, Switzerland, Uruguay, and the Saint-Siège. It is confidently hoped that a great step in advance will be made for realising, what is highly desirable, the unification of weights and measures for different countries. The United Kingdom is represented by the Astronomer-Royal; Dr. H. W. Miller, of Cambridge; and Mr. Chisholm, the Keeper of the Standards. The Rev. Father A. Secchi, S.J., represents the Saint-Siège.

Meteorological Observatory on the Summit of the Puy de Dome.—Rev. F. Moigno.—It appears that the necessary arrangements are made for the immediate establishment of two meteorological observatories—one on the summit of this mountain, situated close to Clermont-Ferrand, in the Department of the Puy de Dome, Central France, the other in the town just alluded to—both to be in telegraphic communication; the difference in altitude between these localities is 1160 metres. Clermont is situated at about 450 metres above sea-level.

Hydro-Electric Submarine Cable.—F. Tomasi.—Illustrated by a series of woodcuts.

Spectroscope with Slide.—M. Hofmann.—The description, illustrated by woodcuts, of an improved spectroscope constructed by the author, of which it is stated that, having been lately inspected by Dr. Tyndall, Mr. Wright, Father Secchi, and others, it has been highly approved of by them.

Although not strictly belonging to chemistry, we call attention to the contents of the following paper:—

Geographical Works.—A. Marie.—The author, Professor at the Normal School of Carlsbourg (Belgium), has invented a greatly improved method of making maps and charts, termed hypsometrical, whereby the countries which are exhibited are shown as they are in their natural state, so that a sound idea of the real configuration of the land, rivers, lakes, mountains, &c., is given at a glance.

Bulletin de la Société Chimique de Paris, August 15, 1872.

This number contains the following original papers and memoirs:—

Essay on the Phosphoplatinic Compounds.—P. Schützenberger and E. Fontaine.—The third instalment of this exhaustive monograph; it contains the following sections:—Action of zinc on the ethyl-phosphoplatinous (*platineux*) ether; amyl-phosphoplatinous ether; action of the phosphoplatinous chloride upon glycerine, allylic alcohol, benzylic alcohol, ammonia, and compound ammonias; phosphoplatinic ethers; methyl-phosphoplatinic ether; ethyl-phosphoplatinic ether. This essay, elucidated by a large number of complex formulæ, is to be continued.

Contribution to the History of Mesoxalic Acid.—J. Ossikovszky.—From chloroxalic ether—

$$C_2O_2\!<\!\begin{matrix}Cl\\OC_2H_5\end{matrix}$$

(prepared by the action of oxychloride of phosphorus upon ethyl-oxalate of potassium), by the action of cyanide of potassium, and next saponification of the cyanoxalate of ethyl thus formed, no mesoxalic acid is obtained, the result of the reactions being the formation of oxalic acid.

Acetyloxamate of Ethyl.—J. Ossikovszky and G. Barbaglia.—The authors describe at length the reaction which takes place when 2 molecules of fused acetamide and 1 molecule of chloroxalate of ethyl are mixed; the final result of this reaction, assisted by heat and purification of the new product, is the formation of a liquid which exhibits the following characters:—It is not precipitated by chloride of calcium; gives off ammonia very abundantly when boiled with concentrated caustic soda solution; nitrate produces a feeble opalescence not dissolved by nitric acid; treated with boiling water,

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it yields a large quantity of acetic ether, which volatilises; while, on evaporation, the solution yields acid oxalate of ammonium—

$$\underbrace{CO-HN-CO-CH_3 \\ | \\ COOC_2H_5}_{\text{Acetyloxamate of ethyl.}} + 2H_2O = \underbrace{CH_3 \\ | \\ COOC_2H_5}_{\text{Acetate of ethyl.}} + \underbrace{COOH \\ | \\ COONH_4}_{\text{Acid oxalate of ammonia.}}$$

By distillation, the substance (acetylomate of ethyl) is decomposed, depositing carbonaceous matter, while acetic ether and acetamide are produced in small quantity; on being kept for a long time, the liquid deposits crystals, which, on analysis, yield results leading to the formula—

$$CO-HN-CO-CH_3 \\ | \\ COOC_2H_5$$

Researches on Guanidine.—J. Ossikovszky.—The author describes at length a method of preparing guanidine as directed by Bannow, and consisting in heating iodide of cyanogen with three times its weight of ammoniacal alcohol (at 10 per cent NH_3) in sealed tubes, followed by a lengthy and rather tedious process of purification; it appears that there is simultaneously formed a fatty acid (probably propionic acid), which, however, was not obtained by the author in free state, Guanidine is, while taking up the elements of water under the influence of hydrate of baryta, readily converted into ammonia and urea, or into the products of decomposition of the latter, viz., carbonic acid and ammonia.

Action of Salts of Lime upon a Decoction of Cochineal.—E. Guignet.—A black-coloured carminate of lime is obtained by treating carminic acid or a decoction of cochineal with a solution of bicarbonate of lime, whereby an abundant precipitate is formed, which is insoluble in water and alcohol, and yields with lime-water a violet-coloured basic carminate of lime; while, when the black carminate is heated along with a solution of neutral acetate of lead, there is formed a bluish-violet coloured carminate of lead. It is necessary to employ in these reactions lime salts quite free from iron, because the decoction of cochineal is precipitated by the salts of that metal, yielding with it black-coloured compounds. It appears that the action of salts of lime upon cochineal is so characteristic that it may be used as a test for lime; the author states that several commercially-sold products, such as glue and starch, for instance, which have been prepared with lime salts containing water, are coloured black by a decoction of cochineal.

Pyrogenic Oils of Pechelbronn (Alsace).—J. A. le Bel.—The exhaustive and detailed description of various products (hydrocarbons) obtained by fractional distillation from the petroleum oil prepared from the bituminous shale met with at the locality alluded to; the author also gives a description of a distillatory apparatus invented by him, and contrived for the purpose of rendering fractional distillation a more readily managed and continuous operation.

Note on some Unfinished Experiments Relating to the Reciprocal Transformation of Dextro- and Levo-Tartaric Acid.—Lecoq de Boisbaudran.

Oxidation of Sugar by means of Permanganate of Potassa.—J. Maumené.—By this oxidation there are formed two acids—Hexépic, $C_{12}H_{12}O_{16}=C_{12}H_{11}O_{15}HO$; and triépic—$C_6H_6O_{10}=C_6H_4O_9HO$.

The author points out in the following manner the relation existing between hexépic acid and acids already long known:—

Hexépic acid,	$C_{12}H_{12}O_{16}$
Saccharic acid,	$C_{12}H_{10}O_{16}$
Malic acid,	$C_{12}H_9O_{12}(C_6H_6O_{10}\times 1\frac{1}{2})$
Tartaric acid,	$C_{12}H_9O_{12}(C_8H_6O_{12}\times 1\frac{1}{2})$
Carbomethylic acid,	$C_{12}H_{12}O_{12}(C_4H_4O_6\times 3)$

Le Moniteur Scientifique Quesneville, No. 370, October, 1872.

This number only contains the two following original communications:—

Estimation of Lithia in Mineral Waters.—F. Wurtz.—As it is difficult to entirely separate lithia present in mineral waters from lime, the following method was applied by the author, while analysing the mineral water of the Madeleine spring of Vals:—15 litres of the water are first evaporated to one-tenth of the original bulk, and the liquid is next filtered, for the purpose of eliminating carbonate and sulphate of lime and earthy matters deposited during the evaporation. To the filtrate is added perfectly pure carbonate of soda in slight excess, in order to precipitate earthy matters kept in solution; after this, the liquid is evaporated to dryness, the residue is treated with boiling distilled water, and the liquid is filtered while hot into a small porcelain or platinum crucible placed on a water-bath. To the hot filtrate, phosphate of soda is added, whereby the carbonate of lithia, hitherto kept in solution, is precipitated as phosphate of lithia, which, with the liquid wherein it is suspended, is evaporated to dryness; the residue is next treated with cold water, and the insoluble salt is thrown on a filter, and, after drying, weighed. In order to test whether there is any phosphate of lime mixed with the phosphate of lithia, the latter is dissolved in perfectly pure and dilute sulphuric acid, care being taken to use no more acid than is just required, according to the weight of the phosphate of lithia obtained. This solution is next treated with neutral acetate of lead, forming insoluble sulphate and phosphate of lead, while acetate of lithia and acetate of lime (supposing the lithia salt to have been still contaminated with lime) are kept in solution; the excess of lead is removed by sulphuretted hydrogen, and the liquid again filtered; some pure and dilute sulphuric acid is again added to the filtrate, and the liquid again evaporated to dryness upon a water-bath. The sulphate of lithia is next treated with boiling alcohol, in which any sulphate of lime which happens to be present is insoluble; the alcoholic solution, previously filtered if the sulphate of lime was present, is lastly evaporated to dryness, and the sulphate of lithia weighed.

Preparation of Alcohol from Sawdust.—M. Zetterlund.—Into an ordinary steam-boiler, heated by means of steam, were introduced 9 cwts. of very wet sawdust, 10·7 cwts. of hydrochloric acid (sp. gr. = 1·18), and 30 cwts. of water; after eleven hours' boiling, there was formed 19·67 per cent of grape sugar. The acid was next saturated with chalk, so as to leave in the liquid only a small quantity (½ degree by Ludersdorf's acid areometer); when the saccharine liquid was cooled down to 30°, yeast was added, and the fermentation finished in twenty-four hours. By distillation, there were obtained 26·5 litres of alcohol of 50 per cent at 15°, quite free from any smell of turpentine, and of excellent taste. It appears that the preparation of alcohol from sawdust may be successfully carried on industrially when it is precisely ascertained what degree of dilution of acid is required, and how long the liquid has to be boiled. When all the cellulose present in sawdust might be converted into sugar, 50 kilos. of the former substance would yield, after fermentation, 12 litres of alcohol at 50 per cent.

Bibliography.—Under this heading we quote the title of a work which is highly spoken of—"Précis de Chimie Légale; Guide pour la Recherche des Poisons, l'Examen des Armes à Feu, l'Analyse des Cendres, l'Alteration des Ecritures, des Monnaies, des Alliages, des Denrées et la Détermination des Tâches dans les Expertises Chimico-Légales; à l'Usage des Médecins, Pharmaciens, Chimistes, Experts, Avocats, &c.," par A. Naquet, Professeur Agrégé de la Faculté de Médecine de Paris; avec 18 figures dans le texte; 1 vol. in 18. Paris, chez Savy, Libraire, Rue Hautefeuille, No. 24; prix, 3 francs.

Sitzungsberichte der Mathematisch-Physikalischen Classe der Königlich Bayerischen Akademie der Wissenschaften zu München, No. 1, 1872.

In addition to several original memoirs relating to natural history, anatomy, geology, and physics, this number contains the following original papers and memoirs relating to chemistry:—

Products of the Decomposition of the Quecksilberfahlerz of Mosschellandsberg in the Pfalz.—F. Sandberger.—The mercury ore which is met with in Rhenish Bavaria has an iron-grey colour, a metallic lustre, a sp. gr. of 5·095, and consists, in 100 parts, of—Sulphur, 21·90; arsenic, 0·31; antimony, 23·45; bismuth, 1·57; copper, 32·19; mercury, 17·32; iron, 1·41; cobalt, 0·23; zinc, 0·10; gangue, 1·39. There is met with at the same locality another quecksilberfahlerz (the German name is retained in Dana's "System of Mineralogy"), the sp. gr. of which varies from 5·509 to 5·511, while, in addition to its containing 24·1 per cent of mercury, it also contains 5·62 per cent of silver. The author treats, further, on the spontaneous decomposition of the first-mentioned ore, and states that, according to his investigation of the weathered mineral, no loss of mercury ensues.

Influence of Absolute Alcohol upon some Chemical Reactions.—Dr. Vogel.—The author records in this paper a series of reactions which are modified, or even entirely suspended, by strong alcohol, in consequence of the insolubility in that fluid of many substances which are soluble in weaker alcohol and in water. Two reactions are more particularly alluded to, viz., that of starched test-paper and tincture of iodine, and the behaviour of metallic potassium with strong (absolute) alcohol. When potassium is put into a basin containing alcohol stronger than 0·823 sp. gr., no ignition of the metal takes place, which is, however, oxidised, and rotates as it does when thrown upon water; when thrown upon alcohol of 0·830 sp. gr., ignition takes place.

Action of Active Oxygen upon Pyrogallic Acid.—H. Struve.—This lengthy essay treats on the action of peroxides and other oxidising substances upon pyrogallic acid alone or in the presence of gum, blood, saliva, malt extract, &c. It appears that pyrogallic acid yields several coloured products of oxidation, among which purpurogallin is one of the most prominent.

PATENTS.

Communicated by Messrs. VAUGHAN and SON, Patent Agents, 54, Chancery Lane, London, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

2450. F. Lipscombe, Strand, Middlesex, "Improvements in the treatment of noxious vapours, and in apparatus or appliances in connection therewith."—Petition recorded August 16, 1872.

2518. W. Lockhead, Glasgow, N.B., "Improvements in treating asbestos or amianthus and applying the same to various useful purposes."—Petition recorded August 24, 1872.

2576. G. Spencer, Cannon Street, London, "Improvements in the purification of coal gas used for illuminating purposes and for mechanical purposes, and in apparatus therefor."—A communication from E. White, New York, U.S.A.—Petition recorded August 30 1872.

2614. B. W. Gerland, Macclesfield, Cheshire, "Improvements in the manufacture of phosphoric acid, phosphatic manures, alkaline, and other phosphates."—A communication from H. and E. Albert, Biebrich, Germany.—Petition recorded September 3, 1872.

2649. W. Meister, Dr. E. Lucius, and Dr. A. Brüning, Hochst, near Frankfort-on-the-Maine, Germany, "Improvements in the manufacture of colouring matter suitable for dyeing and printing,"

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2650. J. C. Ramsden, Lightcliffe, Halifax, Yorks, "A new or improved means or method of and apparatus for securing the combustion of fuel, and for the utilisation of the gases arising therefrom."

2651. S. Carter, Highgate Road, Middlesex, "Improvements in fuel."—Petitions recorded September 6, 1872.

2665. J. Berry, Dublin. "Improvements in the manufacture of peat fuel."—Petition recorded September 9, 1872.

2687. B. B. Standen, Blackheath, Kent, "Improvements in collecting and treating human excrement, both solid and liquid, and in the treatment of other animal urine, also in the means or apparatus employed therein."

2690. T. Jackson and T. Southan, Coatbridge, "The application of titanic iron ore in making and repairing bottoms of heating and reheating furnaces in place of sand, in order to utilise the cinder from such furnaces for fettling puddling furnaces."

2692. F. A. Gatty, Accrington, Lancashire, "Improvements in producing certain colours on cotton fabrics and yarns."

2693. S. J. Mackie, Delahay Street, Westminster, "Improvements in the manufacture and storing of gun-cotton."—Petitions recorded September 11, 1872.

2704. J. Hargreaves and T. Robinson, Widnes, Lancashire, "Improvements in the manufacture of sulphate of soda."—Petition recorded September 12, 1872.

2717. W. S. Dixon, Grosvenor Place, Middlesex, "Improvements in the manufacture of plute iron or refined metal."

2719. W. R. Lake, Southampton Buildings, London, "An improved process and compound for tempering and refining steel."—A communication from W. N. Severance, South Bend, Indiana, U.S.A.—Petitions recorded September 13, 1872.

2745. E. T. Hughes, Chancery Lane, London, "Improvements in the manufacture of the salts, carbonates, and hydrates of baryta and strontia, and also for improved modes of making baryta and strontia caustic."—A communication from L. G. G. Daudenart and E. Verbert, Schaerbeck, Brussels."—Petition recorded September 16, 1872.

2770. A. E. Webb, Stepney, Middlesex, "A process of treating oils, spirits, and fatty matters, whereby they are rendered disinfecting and deodorising during the combustion thereof, and by which the said oils are purified."—Petition recorded September 18, 1872.

2772. J. W. Gray, Billiter Street, London, "An improved explosive compound."—A communication from J. Hall, Place d'Armes, Pas de Calais, France.

2779. A. C. Fraser, Finsbury Park, London, "Improvements applicable to retorts for the manufacture of gas."

2782. G. H. Smith, New York, U.S.A., "An improved method of treating brick, porous stone, and other like materials to increase their hardness, durability, and impermeability."—Petitions recorded September 19, 1872.

2790. R. Stone, Liverpool, "An improved artificial fuel."—Petition recorded September 20, 1872.

2801. J. McDougall, Manchester, "Improvements in the manufacture of manures."—Petition recorded September 21, 1872.

2805. W. Rath, Plettenberg, Westphalia, "Improvements in annealing and removing of oxide or scale from iron and steel wire, and other articles of iron and steel."—Petition recorded September 23, 1872.

2830. G. Smith, Chelsea, Middlesex, "Improvements in enamelling stoneware, Bristol ware, and earthenware of the like nature."—Petition recorded September 25, 1872.

INVENTIONS PROTECTED BY THE DEPOSIT OF COMPLETE SPECIFICATIONS.

2783. J. H. Valleton and J. E. Planque, Great Tower Street, London, "Improvements in the manufacture of bread, biscuits, and pastry."—Petition recorded September 19, 1872.

2786. P. P. F. Michea, Jubbulpore, East India, "New substances for dyeing, printing, and tanning, and the process employed for treating one of such substances."

2787. P. P. F. Michea, Jubbulpore, East India, "New substances for dyeing, printing, and tanning, also applicable for the manufacture of paper and threads or yarns."—Petitions recorded September 20, 1872.

2827. C. J. A. Dick, Pittsburgh, Penn., U.S.A., and G. A. Dick, Cannon Street, London, "Improvements in the manufacture of wires applicable to telegraphic purposes."—Petition recorded September 25, 1872.

NOTICES TO PROCEED.

1421. J. Robey, Manchester, "A new or improved filtering medium, suitable also as a disinfectant and deodoriser."—Petition recorded May 11, 1872.

1466. E. G. Brewer, Chancery Lane, "Improvements in the manufacture of steel, steely iron, and homogeneous metal, and in apparatus therefor."—A communication from F. G. Bazault and J. J. Roche, Paris.

1469. G. Bedson, Manchester, "Improvements in puddling furnaces."—Petitions recorded May 14, 1872.

1521. C. Herveux, Islington, Middlesex, "Improvements in tanning and in apparatus therefor."—Petition recorded May 18, 1872.

1540. H. Kenyon, H. Kenyon, and J. Swindells, Warrington, Lancashire, "Improvements in the manufacture of chlorine and sulphuric acid."—Petition recorded May 21, 1872.

1554. G. Haycraft, Faversham, Kent, "Improvements in the manufacture of pebble gunpowder, and in machinery for the same."—Petition recorded May 22, 1872.

1574. W. R. Lake, Southampton Buildings, London, "An improved process of manufacturing sheet-iron."—A communication from W. Rogers, Apollo, and T. J. Burchfield, Allegheny, Penn., U.S.A.

1583. J. C. Johnson, Newcastle-upon-Tyne, "Improvements in the manufacture of Portland and other cements."—Petitions recorded May 23, 1872.

2332. J. Deere, Briton Ferry, Glamorganshire, "Improvements in the manufacture of artificial fuel."—Petition recorded August 5, 1872.

2341. C. Morfit, Baltimore, Ma., U.S.A., "Improvements in the manufacture of pure phosphates of lime."—Petition recorded August 6, 1872.

2344. C. Morfit, Baltimore, Ma., U.S.A., "Improvements in the chemical treatment of mineral and other crude phosphates of lime."—Petition recorded August 7, 1872.

2357. C. Morfit, Baltimore, Ma., U.S.A., "An artificial substitute for 'redonda guano,' 'alta vela' guano, and other natural phosphates of alumina, to be used in the defecation of sewage, in the manufacture of sugar from cane and beet-root juices, and in the preparation of certain chemical products, such as pure alumina and the alkaline and earthy phosphates and aluminates."—Petition recorded August 8, 1872.

2506. E. A. Cook, Viewville House, Midlothian, N.B., "Improvements in treating animal charcoal."—Petition recorded August 23, 1872.

2044. J. Harvey, Vere, Jamaica, "Improvements in the manufacture of sugar and in apparatus therefor."—Petition recorded September 5, 1872.

2783. J. H. Valleton and J. E. Planque, Great Tower Street, London' "Improvements in the manufacture of bread, biscuits, and pastry."—Petition recorded September 19, 1872.

PATENTS SEALED.

899. W. Garton, Southampton, "Improvements in brewing."—Dated March 25, 1872.

979. W. R. Lake, Southampton Buildings, London, "An improved compound for cleansing carpets and other woven fabrics."—A communication from L. Stern, Boston, Mass., U.S.A.—Dated April 3, 1872.

989. J. C. Sellars, Birkenhead, Cheshire, "Improvements in obtaining hydrocarbon liquids, gas for illuminating and heating purposes, and coke."—Dated April 4, 1872.

1044. W. R. Lake, Southampton Buildings, London, "Improvements in the manufacture of pulp from vegetable fibres for making paper and other materials."—A communication from G. Swift, San Francisco, Ca., U.S.A.—Dated April 8, 1872.

1088. W. R. Lake, Southampton Buildings, London, "An improved process of converting cast-iron, and articles made thereof, into steel."—A communication from H. H. Date, and F. H. Date, St. Catherine's, Ontario, Canada.

1089. J. Anderson, Newbuildings, Londonderry, Ireland, "Improvements in refining iron, in obtaining malleable iron and steel, and in apparatus therefor."—Dated April 12, 1872.

1103. R. Tiernan, Liverpool, "An improved manner of treating tobacco."—Dated April 13, 1872.

1229. C. G. Kleberg, Cannon Street, London, "Improvements in the manufacture of sugar, and in the apparatus employed therein."—A communication from N. Tsherikovsky, Smela, Russia.—Dated April 24, 1872.

1240. H. Gahn, Upsala, Sweden, "Improvements in cosmetics."—Dated April 25, 1872.

1265. E. A. Cowper, Great George Street, Westminster, "Improvements in the process of converting wood and other fibrous materials into pulp, and in apparatus therefor."—Dated April 27, 1872.

1997. W. E. Newton, Chancery Lane, "An improved process for surface-hardening steel."—A communication from G. Ames, Rochester, New York, U.S.A.—Dated July 2, 1872.

2279. J. Brown, Edinburgh, N.B., "Improvements in the treatment of sewage, and in the manufacturing of manures."—Dated July 30, 1872.

FOREIGN PATENTS.

BELGIUM.

31012. A. B. Boyer, "A disinfecting process."—Dated August 8, 1872.

31021. T. L. Dubiez-Lecluselle, "Manufacturing and employing a kind of manure."

31022. C. V. Viard, "So-called 'Condensed Vichy Salt Milk.'"—Dated August 10, 1872.

31042. G. Messerschmidt, "Manufacturing vinegar."—Dated August 14, 1872.

31049. J. J. Bodmer, "Improvements in the manufacture of iron and steel."—Dated August 16, 1872.

31060. J. Anderson, "Improvements in the reduction of oxides."—Dated August 19, 1872.

31076. B. Russ, "Improvements in the manufacture of gas, and treatment of its residues."—Dated August 21, 1872.

31078. P. Schmitz, "A liqueur called 'Sanitary Bitters.'"—Dated June 12, 1872.

NOTES AND QUERIES.

Fusion-Point of Cæsium.—Could your readers favour me with the fusion-point and weight of the metal cæsium?—Thos. W. Hall, M.D., L.R.C.S.E.

Constituent Fatty Acids of Palm-Nut Oil.—I shall be very glad if your readers can inform me what are the constituent fatty acids of palm-nut oil, or tell me where I can learn. I have sought the information in back numbers of the Chemical News, and in Miller's and other text-books; but it does not seem to have been much studied. If you will kindly assist me in this I shall be greatly obliged.—F. H. T. A.

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THE CHEMICAL NEWS.

VOL. XXVI. No. 673.

NEW PROCESS FOR THE MANUFACTURE OF IODIDE OF POTASSIUM FROM THE MOTHER-LIQUORS OF KELP.*

By E. SONSTADT.

THIS process consists in converting the alkaline iodides, contained in the mother-liquors from kelp, into iodates; precipitating the iodic acid by a soluble barium salt; heating the precipitate with solution of sulphate of potassium, which gives iodate of potassium in solution; drying up and melting the iodate of potassium solution, and crystallising the solution of the melted iodide of potassium thus obtained.

The conversion of iodides into iodates in the mother-liquors is effected by one of the following processes. But it is advisable, first, to partially or completely precipitate the sulphuric acid from the mother-liquor by solution of chloride of barium or other suitable barium salt, as thus silicic acid, if present, and other impurities are separated, and the precipitate afterwards obtained of iodate of barium is more manageable. The mother-liquor is then, after separation of the precipitate, melted, to destroy organic matter. The melted mass is dissolved in water, and the solution, after separation from the residue, is, if intended for treatment by any of the processes except the last undermentioned, rendered alkaline by addition of a caustic or carbonated alkali, to such extent that the liquid may contain, for each atom of an iodide in it, five atoms of a caustic alkali, or ten atoms of a carbonated alkali. The liquid thus prepared may then be treated by any of the following processes for conversion of the iodide in it into iodate.

(1.) Chlorine is passed through the liquid until the whole of the iodide is transformed into iodate, but no longer.

(2). Solution of a permanganate is added until a slight permanent colouration of permanganate remains. The liquid is then separated from the manganese precipitate, which latter may be furnaced with soda, or with soda and nitre, to re-form permanganate for another operation.

(3). By passing an electric current through the dilute solution in the way usual in electrolysis. This process would be convenient and economical where the electricity can be obtained from electro-magnetic machines worked by water-power.

(4). In this process, the purified mother-liquor is dried up with addition of an atom of an alkaline chlorate for each atom of an iodate present. The mixture is then cautiously heated below redness until the iodide is converted into iodate.

After the iodic acid is separated from the mother-liquors, the bromide remaining in solution may be converted into bromate by either the processes (1) or (4), and bromide of potassium, obtained by the same methods as used for obtaining iodide of potassium. Processes (2) and (3) are not applicable to the formation of bromate.

* Patent No. 1054, April 10, 1872.

ON THE OCCURRENCE AND DETECTION OF VANADIUM AND TITANIUM IN TRAP-ROCKS.

By RICHARD APJOHN.

WHILE working in the Bonn Laboratorium, under the late Professor Engelbach, he mentioned to me that he had found vanadium and titanium in the trap-rock which occurs in the adjacent Rhine district. Since then, on considering the subject, it seemed to me that it would be a matter of interest to extend the investigation further, and to operate on a number of different specimens of trap-rock. I accordingly undertook, with this object, a series of experiments, which I shall now briefly describe. Three different basalts were made the subject of examination, viz., one from a trap-dyke at Dunamoe, County Wicklow, one from the Giant's Causeway, and one from Vicentine, Italy.

Process for Detection of Vanadium.

Eight grammes of the finely-powdered mineral was fluxed with four times its weight of carbonate of sodium. The fused mass was then allowed to cool, and a small quantity of nitre was added. It was now heated over the Bunsen's lamp, taking care that the crucible did not attain more than a dull red heat. The mass was lixiviated with water, and the aqueous solution was boiled with carbonate of ammonium, and fitered to remove silicic acid. The filtrate was evaporated with hydrochloric acid, and sulphide of hydrogen was passed in to precipitate any metals of the lead group which might be present. The filtered solution was then treated with an equal volume of very concentrated solution of ammonia, and sulphide of hydrogen was passed in till all the free ammonia was saturated.

In the case of each specimen the solution assumed a beautiful intense cherry-red colour, a sure indication of the presence of vanadium. This coloured liquid was filtered off and saturated with hydrochloric acid; the precipitate, containing sulphur and sulphide of vanadium, was dried and ignited, and the residue was melted with a pinch of nitre. From the vanadate of potassium thus formed the characteristic blowpipe reactions were obtained.

Detection and Estimation of Titanium.

Twelve grammes of the finely-powdered rock were fluxed with six times their weight of acid sulphate of potassium, and the heat was continued until the greater part of the free sulphuric acid was driven off. The cooled mass was reduced to a fine powder, exhausted with cold water, and the aqueous solution (it should be largely diluted) was boiled with acid sulphite of sodium. As soon as the precipitation was complete, the contents of the flask were allowed to cool, and a little sulphurous acid was added to re-dissolve any iron or aluminium which might have been precipitated. This precipitate of titanic acid was converted into the titano-fluoride of potassium in the usual manner, and the salt thus obtained was collected on a weighed filter, washed with a few drops of cold water, dried, and weighed; and from this weight the amount of titanic acid was deduced. With a view to testing the accuracy of this result, the titano-fluoride was dissolved in hot water, and the titanic acid was precipitated by ammonia, ignited, and weighed.

The results obtained in these experiments are given in the following table:—

	K_2TiF_6.	TiO_2 calculated from K_2TiF_6.	TiO_2 precipitated by NH_3.	Per cent of TiO_2 in Trap-rock.
12 grms. of Wicklow trap gave	0·660	0·222	0·190	1·58
12 grms. of Giant's Causeway basalt gave	0·240	0·081	0·084	0·70
12 grms. of Vincentine (Italy) basalt gave	0·325	0·110	0·110	0·91

The titanic acid beads, formed with salt of phosphorus in the reducing flame, exhibited that pure amethyst shade which showed that the iron had been completely separated.

It is interesting to observe how closely the titanic acid calculated from the titano-fluoride agrees with that which was found by precipitation with ammonia. The numbers yielded by the two methods are so nearly the same, that small quantities of titanic acid would, I am sure, be best

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estimated by weighing it in the form of titano-fluoride. Such a course would be recommended by the fact of the atomic weight of the titano-fluoride being nearly three times that of titanic acid. The modern analyses of trap-rocks are few in number, and but in one (see Watts's "Dictionary," vol. iv., p. 251) is the presence of titanic acid noticed. It appears to me, therefore, a matter of some importance to put upon record the fact that, in the specimens of this rock which I have examined, both of these constituents occur, and in quantities which admit of estimation. The data are probably insufficient to justify the conclusion that these rare elements exist in all trappean rocks; but the results of the experiments which I have made would seem to invest such a conclusion with some degree of probability.

ON THE

ABSORPTION OF ATMOSPHERIC NITROGEN BY VEGETATION.*

By M. P.-P. DEHERAIN.

Numerous analyses of arable earths now in the possession of agricultural science, have established the fact that there exists in soil a considerable quantity of combined nitrogen, whose origin cannot be attributed to old dressings, inasmuch as M. Boussingault has observed that the amount of nitrogen contained in the vegetation collected during the distribution growth of crops upon a given surface exceeded the quantity contained in the manure which that surface had received. The excess is often considerable, and must be explained either by admitting that plants draw nitrogen directly from the air and fix it in their tissues, or, that in consequence of some reaction as yet but little known, arable earth becomes gradually charged with atmospheric nitrogen, which is then transmitted to the vegetation.

The numerous experiments attempted in France by M. Boussingault, and in England by Messrs. Lawes, Gilbert, and Pugh, in order to ascertain whether plants absorb nitrogen directly from the air, have failed. The production of ammonia or nitric acid by meteoric phenomena, rain, snow, or dew, is scarcely sufficient to cover the loss occasioned by the evaporation of ammonia in the air by the draining of superficial and sub-soil waters, which easily carry away nitrates, and, lastly, by the emission of free nitrogen which is produced during the decomposition of organic matter used as manure. It is therefore evident, *a priori*, that some powerful cause must determine in the soil that fraction of the nitrogen revealed there by analysis. After reflecting upon the various circumstances under which the union of the two elements of the air occurs, it is found to habitually accompany the oxidation of combustible matter; and it seemed to me that oxidation of the organic matter arising from the remains of former vegetation, or from manure, might perhaps produce the combination of atmospheric nitrogen with oxygen.

To render this certain, I resolved to undertake two series of experiments. By the first I have ascertained the absorption of gaseous nitrogen during the oxidation of organic matter. In the second, which will be the subject of a later communication, I examined the nitrogen in combination by endeavouring to point out those reactions which produce the black matter of arable earth. After several attempts, I succeeded in obtaining a regular absorption of nitrogen by the following means. Into a matrass of green glass capable of containing 200 c.c. was introduced a mixture of equal volumes of air and oxygen, whose [illegible] ascertained, and then a [illegible] dissolved in [illegible] months. This [illegible] tion is rapid, only a very insignificant portion of air can enter the matrass. Even should a larger quantity obtain entrance, the experiment will not be spoiled. The proportion of nitrogen in the matrass will become rather larger than is indicated by the analysis, only a small quantity of the nitrogen absorbed passing unperceived. Heat is applied for 100 hours by the water-bath, and when completely cooled the height of the liquid is marked upon the neck of the reversed matrass, and the end is broken under water. With the preceding proportions the absorption is considerable, nothing but nitrogen remaining. All oxygen and carbonic acid will have disappeared; the gas is collected in a graduated éprouvette, the entire absence of oxygen or carbonic acid is ascertained by potash and pyrogallic acid, and the remaining quantity of nitrogen is read off, the quantity being considerably less than what was introduced. Here are particulars of the two experiments. Of 100 parts of gas introduced, 58·40 consisted of oxygen; 41·60 nitrogen; the liquid glucose and ammonia occupied 30 c.c.; and the gas contained in the matrass 184 c.c. Before the experiment there were 76·5 c.c., of nitrogen in the mixture, when, after heating the matrass, the end was broken under water, only 70 c.c. of gas were found, containing neither oxygen nor carbonic acid. 6·5 c.c. of nitrogen were therefore absorbed, or 8·6 per 100.

In one of the experiments made with the nitrated glucose of M. P. Thenard, and with ammonia, with gas containing 52 of nitrogen to 48 of oxygen, an absorption was ascertained of 11·3 c.c. against 53 introduced, that is to say 21·5 per 100.

Six experiments were made with humic acid mixed with potash, acting upon atmospheric air; and of 100 volumes of nitrogen introduced, an average of 7 volumes was absorbed. Two experiments were made with decayed wood mixed with potash; the introduced gas was rich in oxygen, and 3·6 were absorbed per 100 volumes. Upon substituting ammonia for the potash, no absorption of nitrogen was perceived; on the contrary, at the end of the experiment more nitrogen was found than at the commencement. In twenty of these experiments made with glucose and ammonia acting upon equal volumes of air and oxygen, an average absorption was established of 5·9 c.c. of nitrogen to 100 introduced. Lastly, in four experiments in which a mixture of M. P. Thenard's nitrated glucose with ammonia was employed, an average absorption of 15·4 to 100 of introduced nitrogen was observed.

Thus in the presence of slow combustion of organic matter, atmospheric nitrogen enters into combination, probably to form nitric acid, which, from contact with excess of carbonaceous matter is reduced, and yields its nitrogen to the organic matter. This last reaction has been established by M. P. Thenard, and having verified it, we may, by depending upon it, endeavour to imagine what is the origin of the excess of nitrogen found in plants, and in the soil over the quantity furnished by manures. The conditions under which atmospheric nitrogen is brought into combination require that some organic matter should be consumed in the air; every plant which leaves remains upon the soil which bears it is therefore the means of more or less fixation of nitrogen. This reaction continues during many years, and ends by accumulating upon soil abandoned to spontaneous vegetation, such as waste land, a quantity of nitrogen sufficient to enable a cultivator, after clearing, to obtain several crops of cereals without the introduction of nitrated manure. It is thus that prairies and forests suffice for the regular supply of hay and wood without man's interfering to compensate for the periodical losses to which they have been subject from time immemorial.

The productive powers of the soil of forests and prairies are, however, not to be compared to those of arable land. The vegetable remains left upon the former are not in so favourable a state for combustion as those which form the dressing received by the latter, for we have already seen at the nitrated glucose which occurs during the manu-

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facture of farmyard manure is the most favourable of all mixtures employed for the fixation of atmospheric nitrogen. The action of manure upon vegetation is not due only to the six-thousandths of nitrogen which it contains, but also to the decomposing carbonaceous matter which constitutes the entire mass; when buried in the earth, this matter is preserved there some time if the cultivator does not endeavour to finish its oxidation. To this end he tears the earth with his ploughshare, he aërates it, he is unsparing of his means; under the influence of the air the organic matter burns, yielding those considerable quantities of carbonic acid which the analyses of MM. Boussingault and Lewy have discovered in the air entangledin the earth. This combustion determines the union of the two elements of the air, and there is added to the nitrogen which the dressing naturally contains, that which, drawn from the atmosphere, is thence conducted through the series of metamorphoses, which transmit it from the soil to the plant and from the plant to the animal.

What are the conditions of composition, aëration, and of moisture most favourable to the fixation of atmospheric nitrogen in arable soil? This is an important question, since experiment shows that the circumstances under which the combination of gaseous nitrogen occurs are very clearly defined; it does not take place if oxidation is either too rapid or too slow, and it is probable that nitrogen does not become fixed with the same facility in all kinds of earth. Further study of the subject may lead to development of the conditions most favourable to the accomplishment of this remarkable phenomenon, and thus to ascertaining one of the dominant causes of fertility.—*Comptes Rendus.*

WATER ANALYSIS IN INDIA.

By EDWARD NICHOLSON,
Assistant Surgeon, R.A.; Analyst of Waters, Mysore, Northern and Ceded Districts.

IN your columns of the 7th of June (CHEMICAL NEWS, vol. xxv., p. 273) appears a letter from Dr. Macnamara, Chemical Examiner to Government at Calcutta, deprecating my condemnation of the Bengal water analyses made under his superintendence. He states that fifteen years of experience had enabled him to know the peculiarities of Indian waters, that he had fully recognised them, and had caused them to be recognised by his analysts, especially as regards the occurrence of nitrates in unpolluted waters. Now I have looked carefully through seven half-yearly Reports of these analyses, and the remarks made thereon by Dr. Macnamara. I find in them not a trace of any such recognition; on the contrary, I find hundreds of waters condemned because they contain some nitric acid or a rather large amount of chlorides; I even find recommendations that large cantonments shall be abandoned, solely because the amount of these constituents does not please the analysts. I can adduce plenty of facts in support of my assertions, but will content myself for the present with quoting two of Dr. Macnamara's own analyses *in extenso*, so as to show both the chemistry of a scheme elaborated after fifteen years' experience, and the kind of evidence on which waters are condemned.

I may premise by stating that the form of analysis here laid down was obligatory. The "soluble" salts of a water might contain earthy nitrates, sulphates, or chlorides, in addition to alkaline salts, yet they must be given as chloride of sodium, sulphate of soda, carbonate of soda; no deviations were allowed; and an analyst who gave the actual constituents of the water was checked, and ordered to repeat the analysis according to the form ordered.

The two analyses I am about to quote are to be found in the fourth volume of Reports; they will be the best commentary on his statement that "no one would think of condemning a water simply because it contained a large amount of nitrates or of chlorides."

Wells in Fort William, Calcutta.

	Well near Chowringhee Gate.	Well near Treasury Gate.
Physical properties	good	good
Total hardness .. .. .. degrees	6·1	9·8
Permanent ditto .. .. .. „	4·6	1·8
Removable ditto .. .. .. „	1·5	8·
Grs. of oxygen required for organic matter in 1000 grs. water ..	·00012	·000125
Ammonia	„	present
Nitric acid .. .. grs. per gallon	2	1
Total solids .. .. „ „	67·6	38
Volatile matters .. „ „	1·6	1·5
Mineral matters .. „ „	66	36·5
Earthy salts, silica, &c., insoluble .. „ „	29	14·5
Lime, calculated as carbonate „ „	18	10
Silica	traces	traces
Soluble salts	37	22
Chloride of sodium	20·5	12·5
Sulphate of soda	5·5	3·6
Carbonate of soda	not determined.	not determined.

Abstract of Remarks.—These wells are both properly constructed with efficient parapet platform and drain—the first well 41 feet deep, with 6 feet water; the second 29 feet, with 4 feet water. The sepoys who use them consider both waters of good quality. The first well has a bazar 48 feet off; sepoys' quarters are close at hand, and the sepoys bathe and wash their cooking utensils in the vicinity of the well. [I may here explain that a sepoy bathes by throwing a pot or two of water over his head, and then wiping himself dry with his cloth. His cooking utensils consist of a couple of brass vessels, in which rice is cooked and eaten; they are kept beautifully bright by being scoured with sand.] The second well has "no bazar or other permanent source of pollution in the neighbourhood."

I pause, and ask What is the common sense verdict on the above evidence? Two waters, by no means hard if we are to believe the soap-test results, containing a rather large amount of chlorides, a *notable amount of sulphates*, a minimum amount of oxidisable organic matter (0·0002 per 1000 of oxygen is the usual permanganate result in good wells), a small amount of nitric acid for India. Water of good physical properties, considered good by the people drinking it. Wells in perfectly satisfactory condition, neither of them very far from a tidal river (Fort William is on the banks of the Hoogly), in an alluvial delta. No source of pollution in the neighbourhood of one; in the other case, none beyond sepoys' quarters and a bazar. People wash near the well (as they do at every well in India).

Common sense verdict:—Good waters, somewhat affected by the saline deposits natural in an alluvial delta; No. 2 but slightly so. In neither case so much as to render them unfit for drinking if the people using them find them good.

Dr. Macnamara's verdict:—No. 2. "No doubt much of the saline matter in the well is derived from the washings of sepoys' bodies and cooking utensils." No. 1. "No doubt their neighbourhood [the bazar and sepoys' quarters], and the constant washing that goes on, not only of bodies, but of cooking utensils, in the vicinity of the well, is the reason of the impurity of the water."

The plain fact is, that Dr. Macnamara knows no other source of chlorine and nitric acid but animal excreta; he has never taken the trouble to ascertain how far washing, &c., at a properly constructed well will pollute the water in it; he has never observed the fact that the presence of sulphates is presumptive evidence of marine origin in the

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chlorides present; he simply sees chlorine and nitric acid present, and though every other fact is dead against pollution of the well, he looks about till he sees a sepoy washing his body or his brass plates, and the explanation is found. On reference to the analysts' reports, I can find numerous instances where wells described as "surroundings very dirty," "everything connected with the locality of the well dirty in the extreme," contain less than 2 grains per gallon of chlorides. The slightest powers of observation would have shown Dr. Macnamara that, under an Indian sun (aided by Indian crows),* surface pollution, unless of the foulest character, does not affect the sub-soil water, while sub-soil pollution, such as that of cess-pits, &c., exercises a most striking influence. I render every justice to Dr. Macnamara's industry and zeal; he, however, lacks at least one qualification necessary to the analyst of waters, the faculty of observation.

What can be expected of analyses made according to the form I have quoted? Let any one compare the following points in them:—

	No. 1.	No. 2.
Total hardness, degrees	6·1	9·8
Lime calculated as carbonate, grains	18	10
Mag. carb. (by difference)..	11	4·5
Total insoluble earthy salts ..	29	14·5

These are analyses made by the author and superintendent of the system; the character of those made by the analysts can readily be imagined.

As a rule, the only waters that escaped condemnation were river waters, as they cannot contain nitrates in sufficient quantity to be detected by the rude qualitative estimation ordered by Dr. Macnamara, and no amount of pollution seems to increase their chlorides. But when we come to the wells, the havoc played amongst them by the analysts is terrible; with a few exceptions, they seemed to vie with one another in piling up sanitary horrors. Here is a specimen, taken at chance, of a well-water in a rather brackish district, as may be told at once by the quantity of sulphates present:—

Well No. 11, *Dinapore.*

Physical qualities	good	
Total hardness	8·47	
Permanent ditto	6·3	
Removable ditto	2·17	
Grs. of oxygen, &c., per 1000 grs.	·000125	
Ammonia..	present	
Phosphoric acid	traces	
Nitrous acid	present	
Nitric acid, grs. per gallon	about 17	
Total solids „ „	80·5	
Volatile matters	20·51	
Mineral matters	59·99	
Earthy salts and insoluble	36·05	
Lime calculated as carb.	25·34	
Silica	trace	
Soluble salts	23·94	
Chloride of sodium	13·44	
Sulphate of soda..	6·29	(23·54)
Carbonate of soda	3·81	

"The surface of the water in the well regularly littered with dirt. No care seems to be taken to keep the well even in a decent state."

Notwithstanding the terribly bad state of the well, as given in the remarks, the amount of oxygen by the permanganate is a minimum. But the remarkable points, analytically, are the vast amount of volatile matters, and the non-appearance of any of the nitric acid amongst the regulation "soluble" salts. There is also a slight want of coincidence between the hardness, 8·47° (it was evidently taken very accurately), and the 36·05 grains of calcium and magnesium carbonate. I think that this specimen, out of hundreds, justifies my using the term "skittles" as the only qualification that can be applied to Dr. Macnamara's system of water analysis.

One word more. Dr. Macnamara says: "If I were now instructed by Government to do over again the work lately done in Bengal, I should feel much inclined to put into the hands of the analysts Messrs. Wanklyn and Chapman's work on "Water Analysis," &c. This is no doubt very flattering to the gentlemen named; unfortunately, Dr. Macnamara had the very opportunity he mentions within three months of the date of his letter. At about that time, the officers who perform the ungrateful duties of water analysts in India received each, not a copy of Messrs. Wanklyn and Chapman's treatise and some apparatus to work it with, but a copy of Dr. Macnamara's own new scheme, consisting of a patchwork of forty-six processes acknowledgedly picked out of books and put together without even being tried. In this scheme, like the first, there is not a trace of practical acquaintance with Indian waters.

* The crows and ants consume everything eatable that is cast away; other refuse (and there is but little that crows and ants will not eat) is dried up by the sun.

ON THE TESTING OF MILK.*

By J. ALFRED WANKLYN,
Corresponding Member of the Royal Bavarian Academy of Sciences.

HAVING had occasion to examine a large number of specimens of milk during the past year, I have made some observations on the subject which possibly may not be deemed to be unworthy of the attention of those chemists who may have a like task before them.

The two common forms of malpractice which occur in the milk trade are—the practice of removing the cream from the milk, and the practice of diluting the milk with water; and the testing of milk resolves itself into the detection of skimming and watering, and the measurement of the extent to which these operations have been carried.

The possibility of detecting whether or not a specimen of milk has undergone impoverishment depends obviously on the possibility of assigning a normal composition to milk, or, at any rate, on the possibility of fixing limits beyond which the composition of milk does not vary.

From the observations of Alexander Müller and Eisenstuck, who carried out an investigation for the Royal Agricultural Society of Sweden, it appears that the milk yielded by a herd of cows remains very constant in composition throughout the year. A daily analysis of the milk given by fifteen cows, of different breeds, but uniformly well fed, exhibited the percentage of solids in the milk as never once during the entire year having fallen so low as 11·5. The highest percentage of solids was 14·08. Only four times during the year did the solids fall below 12 per cent. The average was 12·8 per cent.

My own observations, made on an entirely different plan, fully bear out the statement that cows' milk does not fall so low as 11·5 per cent of solids, and seldom so low as 12 per cent.

The following analyses may be published:—

	Date.	Description.	Percentages. Cream.	Solids dry at 100° C.	Ash.
I.	17 Feb., 1871	D. R.	10	12·24	0·76
II.	18 Feb., „	D. R.	—	12·04	0·68
III.	21 Feb., „	Cambridgeshire.	16	12·28	—
IV.	„ „	Surrey.	11	12·22	—
V.	„ „	Herts.	11	13·08	—
VI.	„ „	Essex.	11	11·80	—
VII.	„ „	Essex.	—	14·34	—
VIII.	March, „	Country Milk.	9·8	12·45	0·71
IX.	„ „	Town-fed Milk.	13·0	14·07	0·74
X.	April, „	Alderney Milk.	11·5	12·65	0·70

The first two specimens, named D. R., were specimens of milk bought from milk dealers believed to be perfectly

* Communicated by the Author.

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honest. The next five specimens were samples of milk produced on farms in the different counties named in the table. Specimen VIII. is a sample taken by myself out of some 50 or 60 gallons of milk fresh from the country. Taken altogether, the ten analyses represent the composition of an immense quantity, and of a great variety, of milk, and support the conclusion arrived at in Sweden by Müller and Eisenstuck.

Before leaving the subject of the normal composition of milk, it is right to refer to the laborious investigation by Goppelsröder (*vide* "Verhandlungen der Naturforschenden Gessellschaft in Basel," 1866), which, at first sight, would seem to be in opposition to the above.

In reference to Goppelsröder's paper, the remark should first be made that that chemist does not appear to deny that the solid residue in the milk of a herd of cows keeps constantly above the level just indicated. The point which he insists upon is, that the milk of a single cow sometimes falls in richness below the normal level, and observations are cited in support of this statement. An examination of the results given in his paper does not lead me to a similar conclusion. In his paper I find many determinations of the solids in milk believed to be unsophisticated. Only four out of the entire number fall below 12 per cent. Now it is obvious that, however constant milk may happen to be as a matter of fact, it must always be possible, by a sufficient multiplication of analyses, to exhibit an analysis showing the sample of milk as having a composition outside the normal limit of variation. In other words, there is such a thing as error of experiment, and the question to be asked respecting Goppelsröder's four isolated cases of milk showing less than 12 per cent of solids, is, whether this divergence from the standard composition is real or only an error of observation. Two of these instances occur in Table I., at the beginning of the paper. Among eighteen samples of milk, yielded by a single cow in eighteen consecutive days, he finds one sample yielding 10·69 per cent of solids, and another yielding 11·41 per cent. In the same table Goppelsröder records the percentage of cream, and the specific gravity of the milk before and after skimming. It is remarkable that the two low percentages of solids are not accompanied by low yields of cream or low specific gravities. The former of the two (viz., the 10·69 per cent of solids) is accompanied by 10 per cent of cream, sp. gr. 1·0316 before skimming, and sp. gr. 1·0332 after skimming; the latter (viz., the 11·41 per cent of solids) by 11·2 per cent of cream, sp. gr. 1·032 before and sp. gr. 1·034 after skimming. The third instance of a too-low solid contents is to be met with in Table III., being the evening milk given by the last of eight cows. Percentage of solids, 11·43; cream, 7·5 per cent; sp. gr. before skimming, 1·0315; sp. gr. after skimming, 1·0335. In this instance the cream is indeed rather low, but then the effect of skimming on the specific gravity of the milk is considerable, and the specific gravity is high.

It is perfectly true that if a little cream be removed from rich milk, and a little water (I believe it should be warm) be added to the milk, the creamometer and "lactodensimeter" may be cheated, so that there shall be want of correspondence between the indications of these instruments and the solids in the milk. But in the examples at present under discussion we are not dealing with skilfully sophisticated milk, but with milk in the natural condition as given by the cow. If the figures in the tables be correct, the cow must have, in these three instances, given milk not only abnormally poor in solids, but also in an abnormal physical condition, as if it had been manipulated by the fraudulent milk-dealer.

The fourth case of abnormally low solids occurs in Table IV., being the milk of the third cow, which is recorded as containing 9·54 per cent of solids. In this instance, unfortunately, the yield of cream is not given. The sp. gr. before skimming was 1·0279, but the sp. gr. after skimming is not given. I observe, moreover, that the next solid contents of the table is a misprint, viz., 3·7677 instead of 13·7677 (that it is a misprint is shown by the numbers for the ash and the number given as the ratio of the ash to the total solids).

I do not consider that Goppelsröder's four exceptional cases are sufficiently well established; and I consider it to be a well-established fact that the milk of a herd of cows in good condition always contains more than 11·5 per cent of solids, and that single cows almost invariably (if not always) yield milk containing more than 11·5 per cent of solids.

In dealing with milk supply on the large scale, we are little concerned with the possibility of single animals giving abnormal milk, and need only concern ourselves with milk of normal quality, all departures from the standard being looked upon as sophistications.

The following, which is the result of several concordant analyses of country-fed milk, may be taken as representing normal milk. In 100 grms. of milk:—

Solids (dry at 100° C.)	12·5 grms.
Water	87·5 "
	100·0

The 12·5 grms. consist of 9·3 grms. of "solids which are not fat," and of 3·2 grms. of fat.

If we consider the changes in composition which the addition of water to milk will produce, it will be apparent that it must diminish the proportion of solids in the milk, whilst the effect of skimming is to diminish the proportion of fat, and to leave the proportion of "solids not fat" unaltered (or indeed, strictly speaking, to make a very trifling increase in the proportion of the "solids not fat").

Treating the question quite rigidly, which I believe is the proper way of dealing with it, we arrive at the following:—

Problem I.—Given the percentage of "solids not fat" ($=a$), in a specimen of sophisticated milk (*i.e.*, milk either watered or skimmed, or both),—required the number of grammes of genuine milk which was employed to form 100 grms. of it.

Answer.—Multiply the percentage of "solids not fat" by 100, and divide by 9·3. Or—

$$\frac{100}{9{\cdot}3}a.$$

Problem II.—Given the percentage of "solids not fat" ($=a$), also the percentage of fat ($=b$), in a specimen of sophisticated milk,—required the number of grammes of fat which have been removed by skimming from the genuine milk which was employed to form 100 grms. of it.

Answer.— $$\frac{3{\cdot}2}{9{\cdot}3}a-b.$$

In translating fat into cream, the rule is that a removal of 0·2 grm. of fat equals a removal of 1·0 grm. of cream. This rule is directly founded on experiment. I do not, however, claim a high degree of accuracy for the measurement of the cream.

Finally, a slight refinement may be noticed. If a specimen of sophisticated milk have been produced by both skimming and watering, it will be obvious, on consideration, that the extraneous water employed in manufacturing 100 grms. of it is equal to the difference between 100 and the quantity of genuine milk employed to make 100 grms. of sophisticated milk, together with a quantity of water equal to the fat removed by skimming.

$$\text{Extraneous water} = 100-\frac{100}{9{\cdot}3}a+\frac{3{\cdot}2}{9{\cdot}3}a-b.$$

$$=100-\frac{100+3{\cdot}2}{9{\cdot}3}a-b.$$

An investigation of the different milks supplied to the different London Unions (which was made by me for the Government, at Mr. Rowsell's instance, last year, and which is published in Mr. Rowsell's "Report on the System of Supply of Provisions for the Workhouses of the Metropolis"), will furnish an illustration of this method of interpreting the results of milk-analysis.

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		In 100 Grammes of Sample of Milk.		Calculated.			
		Grms. of Solids not Fat.	Grms. Fat.	Grms. of Genuine Milk.	Grms. of Fat Removed.	Grms. of Cream Removed.	Grms. of Extra Water.
		a.	b.	$\frac{100}{9.3}a$.	$\frac{3.2}{9.3}a-b$.		$100-\frac{100}{9.3}a+\frac{3.2}{9.3}a-b$.
Bethnal Green (St. Matthew)	I.	9·04	1·22	97·2	1·89	9·45	4·7
" "	II.	4·38	2·08	47·1	−0·57	−2·85	52·3
Camberwell (St. Giles)	I.	8·37	1·14	90·0	1·74	8·70	11·7
" "	II.	8·94	0·96	96·1	2·12	10·60	6·0
Chelsea (St. Luke)	I.	9·36	2·24	100·6	0·98	4·90	0·4
" "	II.	7·48	2·86	80·4	−0·28	−1·40	19·3
Fulham Union	I.	9·09	1·52	97·8	1·61	8·05	3·8
"	II.	9·30	1·80	100·0	1·40	7·00	1·4
St. George's Union	I.	9·52	2·44	102·6	0·84	4·20	−1·8
"	II.	9·08	2·82	97·6	0·31	1·55	2·7
St. George-in-the-East	I.	6·55	2·32	70·5	−0·06	−0·30	29·5
"	II.	5·92	1·30	63·7	0·74	3·70	37·0
St. Giles-in-the-Fields and St. George, Bloomsbury	I.	9·13	1·50	98·2	1·65	8·25	3·4
	II.	7·17	1·96	77·1	0·51	2·55	23·4
Greenwich Union	I.	6·60	2·32	71·0	−0·05	−0·25	29·0
"	II.	6·38	1·98	68·6	0·21	1·05	31·6
Hackney Union	I.	9·09	3·50	97·8	−0·47	2·35	1·7
"	II.	7·40	2·54	79·6	0·00	0·00	20·4
Hampstead (St. John)	I.	8·44	1·50	90·7	1·40	7·00	10·7
" "	II.	7·74	3·00	83·3	−0·34	1·70	16·4
Holborn Union	I.	8·27	1·84	89·0	1·01	5·05	12·0
"	II.	7·64	2·40	82·1	0·23	1·15	18·1
Islington (St. Mary)	I.	7·70	0·92	82·8	1·73	8·65	18 9
" "	II.	7·06	1·45	75·9	0·98	4·90	25·1
Kensington (St. Mary Abbott)	I.	8·04	0·60	86·0	2·17	10·85	16·2
" "	II.	6·08	1·26	65·4	0·83	4·15	35·4
Lambeth (St. Mary)	I.	6·54	1·56	70·4	0·69	3·45	30·3
" "	II.	7·08	1·22	76·1	1·22	6·10	25·1
Lewisham Union	I.	6·42	0·96	58·3	0·90	4·50	42·6
"	II.	5·95	1·30	64·0	0·75	3·75	36·7
London (City of) Union	I.	8·84	2·82	95·1	0·22	1·10	5·1
" "	II.	6·26	1·10	67·3	1·05	5·25	34·0
St. Marylebone	I.	7·84	1·14	84·3	1·56	7·80	17·3
"	II.	9·44	3·06	101·5	0·19	0·95	−1·3
Mile-End Old Town	I.	9·55	1·96	102·7	1·32	6·60	−1·4
"	II.	8·70	1·80	93·6	1·19	5·95	7·6
St. Olave's Union	I.	7·17	1·86	77·1	0·61	3·05	23·5
"	II.	7·70	1·86	82·8	0·79	3·95	18·0
Paddington	I.	7·22	1·44	77·7	1·04	5·20	23·3
"	II.	6·06	2·16	65·2	−0·07	−0·35	34·7
St. Pancras	I.	7·22	1·12	77·7	1·37	6·85	23·7
"	II.	4·94	1·64	53·1	0·09	0·45	47·0
Poplar Union	I.	7·40	0·76	79·6	1·79	8·95	22·2
"	II.	5·96	0·90	64·1	1·06	5·30	37·0
St. Saviour's Union	I.	6·65	2·10	71·5	0·19	0·95	28·7
"	II.	6·30	1·90	67·7	0·27	1·35	32·6
Shoreditch (St. Leonard)	I.	9·99	1·48	107·4	1·96	9·80	−5·4
" "	II.	9·44	2·36	101·5	0·89	4·45	−0·6
Stepney	I.	4·98	0·78	53·6	0·93	4·65	47·3
"	II.	5·09	0·58	54·7	1·17	5·85	46·5
Strand Union	I.	9·56	1·64	102·8	1·65	8·25	−1·2
"	II.	9·16	2·46	98·5	0·69	3·45	2·2
Wandsworth and Clapham Union	I.	8·78	1·50	94·5	1·52	7·60	7·0
"	II.	8·66	2·86	93·1	0·12	0·60	7·0
[redacted]	I.	5·62	0·68	60·4	0·25	1·25	39·8
	II.	6·06	1·90	65·2	0·19	0·95	35·0

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In column 1 is given the designation of the sample, viz., the name of the Union which furnished it, and the number of the sample.

In column 2 is given the number of grms. of "solids not fat" contained by 100 grms. of the sample.

In column 3, the fat.

In column 4, the number of grms. of genuine milk which was employed in making the 100 grms. of sample (calculated).

In column 5, the number of grms. of fat removed by skimming from 100 grms. of sample (calculated).

In column 6, the number of grms. of cream which had been skimmed off 100 grms. of sample (calculated).

In column 7 is given the number of grms. of extra water which had been put into 100 grms. of sample (calculated).

Inasmuch as I have submitted the analyses of these workhouse milks to severe and elaborate treatment, it is right that some particulars should be recorded concerning the manner in which they were conducted. The ash of each milk was determined, and in no instance was it excessive in amount, showing that no mineral had been used to adulterate the milk. For organic adulteration I made no elaborate analysis; but no indication of such adulteration presented itself in the course of the examination: furthermore, I should add that I have never yet met with a case of adulteration of milk with organic substances, and believe it to be of very rare occurrence.

The solid residue dry at 100° C. was taken with great —and I believe unprecedented—accuracy. I have made a study of the taking of milk-residues, and set down the average experimental error in the solid residue as not more than 0·02 per cent. The solid residues were taken twice over, and the mean of the two closely-agreeing determinations was employed in the construction of the table.

The facts were taken with great care, but they do not pretend to so high a degree of accuracy as the total solids. It is hardly necessary to add that the numbers (designated as a) in the column headed "Grms. of Solids not Fat" were obtained by subtracting the quantity of fat ($=b$) from the quantity of total solids dry at 100° C.

The calculation of the quantities of genuine milk employed in making 100 grms. of the samples is based on the assumption, which I believe to be warranted, that milk is tolerably uniform in strength, consisting of 9·3 parts "solids not fat," 3·2 parts of fat, and 87·5 parts of water. This is the composition of country-fed milk. There is, however, an exceptionally rich milk given by highly stall-fed cows in town. This milk contains 10·0 parts of "solids not fat," 4·0 parts of fat, and 86·0 per cent of water; but it is comparatively rare.

If, in any instances in the above table, this rich stall-fed town milk have been employed instead of average country milk, then the real amount of watering and skimming in those instances is a little higher than the table exhibits. In the table there are seven examples of more than 100 grms. of genuine milk being used in making 100 grms. of the sample. Of these one appears to be an example of this town-fed milk, the rest not being sufficiently above 100 to call for such a supposition. The example to which I refer is the Shoreditch milk, which on the first occasion yielded 9·99 per cent of "solids not fat," which is a very close approximation to the "solids not fat" in 100 parts of town-fed milk.

When a exceeds 100 a minus-quantity will correspond to it in column 7, unless the slight correction for fat obliterate the minus-quantity of water. On calculating for town-fed instead of for country-fed milk, the minus-quantities in column 7 will disappear in every instance. The calculation for town-fed milk instead of for country-fed milk, as in the table, is simple, viz., substitute $10a$ for $\frac{100}{9{\cdot}3}a$; substitute $0{\cdot}4a$ for $\frac{3{\cdot}2}{9{\cdot}3}a$.

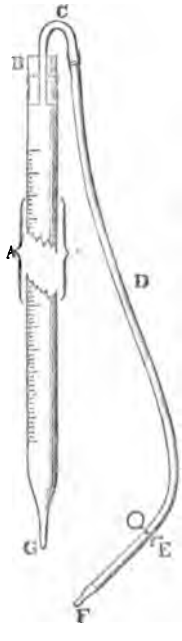
The occurrence of minus-quantities in the column headed "Fat Removed" requires a word of explanation. These minus-quantities have a real and substantial meaning. They are the quantities of fat which have been the reverse of removed,—that is to say, which have been added to the milk. Whenever one of these minus-quantities occurs in the "Fat Removed" column, one of three things has happened:—either the minus-quantity is within the limits of experimental error, as is the case with three of them (viz., −0·06, −6·05, and −0·07), or the milk was town milk, or the milk had through imperfect mixing received an undue share of the cream. There are only four cases of the kind in the table, viz., −0·57, −0·28, −0·47, and −0·34.

ON A

SIMPLE MODIFICATION OF MOHR'S BURETTE, TO ADAPT IT FOR ALL TEST-FLUIDS.

THOSE who are much in the practice of volumetric analysis with Mohr's burette must often have felt great annoyance at the necessity of changing the instrument when operating with certain tests such as permanganate and others which act chemically upon the caoutchouc connectors. The extreme simplicity of Mohr's, and the facility with which it can be used, renders it by far the most desirable instrument; and for this reason it has been attempted to obviate this defect by a glass stopcock, which, while adding considerably to the cost, is by no means satisfactory in use; remarks which equally apply to Binks's and Gay Lussac's forms of burette.

The difficulty has, however, just been overcome in a simple and thoroughly effective manner by Capt. Heriot, R.M., and Mr. R. Biggs, surgeon, of Bath; and we present our readers with a sketch and explanation of the arrangement adopted by these gentlemen.



A represents Mohr's burette, with the caoutchouc connector, pinch-cock, and delivery tube removed. B, a sound cork fitted with a bent glass tube, C, firmly fixed into the mouth of the burette. D, a piece of caoutchouc tube sufficiently long to reach the table, terminating in a small glass mouth-piece, F. The pinch-cock, E, is affixed to the tube D at any part most convenient to the hand of the operator.

The advantages claimed for this arrangement are as follows:—

(1). That one form of burette (and that the best, viz., Mohr's) is available for every test-fluid, as under no circumstances can it come in contact with anything but the glass tube.

(2). That however narrow, such burette can be readily filled without the admission of air bubbles, by simply immersing the lower end, G, in the test-fluid, opening the pinch-cock, and applying suction to the mouth-piece, F.

(3). The extreme ease with which the apparatus can be washed, without even removing it from the stand, it being only necessary to remove the pinch-cock, and produce a syphon by drawing a continuous stream of water through it.

(4). The readiness of application to existing burettes at nominal cost.

It may be well to mention that as by this arrangement the orifice G becomes the terminal dropping tube, it would be advisable in new instruments to constrict its diameter so as not to deliver too quickly; and also that

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in cases where a narrow burette or pipette is used, the cork and glass tube may be dispensed with, and the india-rubber applied directly to its upper end.

DIFFUSION OF MERCURIAL VAPOUR.

By M. MERGET.

The only labours whose object has been the diffusion of mercurial vapours are those of Faraday, which are already half a century old, and whose conclusions, never having been contested during this long period, are accepted as facts acquired by science. The illustrious English physicist is known to have used as a reagent a gold-leaf suspended over mercury, which would blanch by amalgamation, or preserve its colour according to the emission or non-emission of vapour. After two experiments, one positive, the other negative, and availing himself, moreover, of facts previously observed by Davy relative to the transmission of electricity in the barometric vacuum, he was led to form the two following conclusions:—

(1). That the phenomenon of vaporisation of mercury is not continuous, and that its production absolutely ceases below the limit of about 50°.

(2). That at temperatures above that limit, and for a portion of the thermometrical scale which is not indicated by him, the vapours emitted contrary to the general law of diffusion of elastic fluids form above the generating liquid a very thin layer of vapour, which at an ordinary temperature scarcely attains a few centimetres thickness.

These conclusions are, on one hand, in direct contradiction to empirical and theoretical formulæ; explaining the maximum tension of vapours of perfect liquids with regard to temperature, and which all tend to admit implicitly the theory of continuous evaporation; and, on the other hand, they are also at variance with the ideas which now obtain as to the composition and properties of elastic fluids.

Opinions at the present time are generally unanimous in regarding gases and vapours as composed of molecules which move with considerable rapidity; that rapidity as regards each, depending on its nature and its temperature. Vapours which, when once formed, possess all the general properties of gas, are explained to consist of a detachment of molecules from the mass of generating liquid, which escape from its open surface at an average rate of speed to a height which increases with their temperature, and whence, in falling, they acquire the same rapidity of descent.

Faraday's experiments do not appear to me so decisive either by number or exactitude, as to prevent all doubts as to their correctness; which might be aroused by their opposition to a theory so plausible as the dynamic theory of gases.

These doubts having led me to retrace them, my first care was to obtain a reagent more impressionable to mercurial vapours than leaf-gold. Several others can be substituted; and of these, the most sensitive are saline solutions of the precious metals.

When spread upon common paper, after the addition of hygrometric substances which retard their desiccation, these solutions are reduced by mercurial vapour according to the laws of Richter. The reduced metal again covers the paper, and communicates to it tints which become darker and darker, ending definitely in black; but of various tones according to the nature of the metals, and clearly characteristic of each.

The most common salts of the precious metals, such as nitrate of silver, the soluble chlorides of gold, platinum, palladium, and iridium, are those which have the best effect in the preparation of sensitive paper; moreover, as the sensibility of nitrate of silver is increased by the presence of ammonia through the action of that base upon *the nitrate of* mercury formed, it was thought that to render the nitrate of silver ammoniacal would be advantageous, and experience confirms the supposition. Ammoniacal nitrate of silver, with which a few traces are drawn with a pen upon common paper, is the best reagent; but since paper impregnated with it becomes slightly tinged in the light, and also changes in the dark, although slowly, its employment must be dispensed with in long experiments, or in those made by too bright a light, such as that of the direct solar ray. In such cases, substitution may be made of the chlorides of palladium and platinum, which are almost unalterable either photo-chemically or spontaneously. By employing according to circumstances one or other of these three reagent papers, I have established the following facts:—

(1). That the vaporisation of mercury is a continuous phenomenon, which is not interrupted even by the solidification of the metal.

(2). That the vapours emitted possess a considerable diffusive power, which, without being exactly measurable, does not apparently differ widely from the amount assigned to it, *a priori*, by the deductions of the dynamic theory of gases.

The second of these conclusions arises from experiments made in very large and lofty spaces, where I found, from the floor to the ceiling, mercurial vapour emitted from very feeble evaporating surfaces of that metal. The first is the result of numerous experiments made at all temperatures included between $+25°$ and $-26°$C., and of four experiments made at the temperatures of $-30°$, $-35°$, $-40°$, $-44°$.

I may draw attention to a last point of resemblance between mercurial vapours and the other elastic fluids, namely, the property which they possess of being condensed by a certain number of bodies absolutely devoid of all chemical action upon them, such as carbon, platinum; and of penetrating with extreme facility such porous substances as wood, unglazed porcelain, &c. From the preceding facts, numerous deductions may be drawn, of which I shall indicate only the principal. I establish first, in the domain of chemical analysis, the increase of exactitude and sensibility given to the process of qualitative examination of mercury, by the employment of ammoniacal nitrate of silver. It is known that in those experiments where the wet process is employed, the formation of an amalgam determined by simple precipitation upon a sheet of copper, or electro-chemical precipitation upon a sheet of gold, the amalgam being recognised first by its white colour; and, secondly, by the disappearance of that colour when it is heated. If, however, the liquids to be tested do not contain a sufficiently considerable quantity of mercury, the changes produced are of too undecided a character to be of any service. In these cases where no trace of amalgamation is discernible by the eye, whatever test may be employed, it is only necessary to apply the sheet of copper or gold to ammoniacal nitrate of silver paper in order to obtain a brown colour characteristic of the presence of mercury. In this manner I was enabled to establish the presence of mercury in solutions of the bichloride at $\frac{1}{1000000}$.

In experiments by the dry process, the mercurial vapours set at liberty were deposited upon the cold parts of the apparatus, where it was endeavoured to collect them into drops visible to the naked eye, or to the microscope; but this is not practicable if too small a quantity of mercury be employed. The slightest traces of vapour totally insufficient to yield a perceptible deposit, are, however, clearly shown by paper sensitised with salts of silver.

Reciprocally, the salts of precious metals are distinguished from all others by the effects of colouration, which result from their exposure to mercurial vapours; the shades of the darker tints which they then assume being to a certain extent characteristic of the kind of metal. Salts of platinum and of iridium, on account of the unalterability of the constituent metals, may be used to trace with pen or brush, not only on paper, but also on

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the surfaces of all bodies incapable of chemically modifying them, characters or designs which, after reduction by mercurial vapours, are incapable of attack by almost all chemical agents.

The employment of these salts, together with mercurial vapour, is therefore an easy process for manufacturing indelible inks, suitable for writing or drawing on paper, linen, wood, &c. When formed with salts of gold, palladium, and silver, these inks, though less unalterable, may be used with advantage in particular cases.

Instead of using the solutions of these different salts as writing or drawing inks, they may be spread in thin layers upon common paper, and then exposed to the vapours emitted by drawings or characters previously mercurised. By thus reversing the question, I succeeded in resolving under new conditions, the problem of photographic impressions without light.

To do this it is only necessary to obtain a positive on glass, or even on paper suitably prepared with mercurial vapours, which are powerfully condensed by silver, and which it abandons when the plate is pressed upon a sheet of paper sensitised with a solution of one of the salts of the precious metals.

The proofs thus printed, when arising from a silver salt, are cleared and fixed by the usual photographic processes. When formed by salts of gold, palladium, platinum, or iridium, the clearing is naturally suppressed, and the fixing is obtained merely by washing in pure water. The proofs, after this unique and simple manipulation, are absolutely unalterable by light and all atmospheric agency. Moreover, those formed by reduced platinum or iridium are indelible, and cannot be destroyed except by such agents as will at the same time produce great changes in the substance of the paper upon which they are printed.

Substitution might advantageously be made for glass plates of metal sheets prepared for engraving, either by the application of photo-chemical processes, or by the graver, previously mercurising those portions of the sheet where the metal has been laid bare.

The permeability of porous bodies by mercurial vapour, allowed of my obtaining on sensitised paper impressions of leaves and plants; not only reproducing with irreproachable fidelity the finest details of the model, but causing them to stand out vigorously, by strong effects of contrast. When drawn from choice models, these impressions would make interesting collections of specimens for botanical lectures; and the process by which they were obtained might certainly be utilised in researches into vegetable anatomy and physiology. In animal physiology the study of questions relating to the effect of mercurials upon animal economy might be facilitated by the use of reagents which reveal the smallest traces of poisonous or medicinal agents, thus enabling their effects and mode of action to be more exactly studied.

A series of experiments made upon animals of small size, establish that mercurial vapours inhaled by them in open air are mortal in their effects. I therefore have commenced the study of this subject, which naturally bears much upon the health of those occupations into which the employment of mercury enters.

With regard to this subject, I will give an account up to the present time, of the general results of some observations made in a large workshop for silvering glass, occupying a large space, well ventilated, and all the appointments of which are perfectly appropriate for the carrying on of such an occupation.

In spite of the exceptionally advantageous hygienic conditions of these premises, I found that in the large apartment in which the mirrors received their coating, the atmosphere was at all times saturated with mercurial vapour from the floor to the ceiling; and that, although the workmen were in it only four hours a day, their skins, hair, beards, and all parts of their clothes were so strongly impregnated with condensed mercury, that even when not in the workshop, they were subject to the deleterious emanations of that metal. A means of relieving them from this perpetual salivation is indicated in my memoir. —*Comptes Rendus.*

PROCEEDINGS OF SOCIETIES.

THE SCIENTIFIC AND MECHANICAL SOCIETY, MANCHESTER.

SECTION I.—ENGINEERING.

THE fifth monthly meeting of the session of the above Society was held on Wednesday, the 2nd inst., at the Trevelyan Hotel, the Vice-President in the chair.

The following gentlemen were elected Members of the Society :—Messrs. R. L. Mestayer, C.E., C. J. Allport, M.E., Frank Spence, Peter Spence, John Gilchrist, Peter Hart, Ivan Levinstein, James Nalder French, Chemical Manufacturers; Theodore Grosse, Charles Waring, C. S. Allatt, Alexander McKenzie, Mechanical Engineers; E. A. Axon, Nathaniel Cartwright, and A. Esilman.

By the unanimous vote of those present, a member was expelled from the Society, in consequence of not having put in an appearance at the last meeting, when the duty devolved upon him of reading a paper. The Secretary received no reply to his communications to him, and the last was returned through the Dead-Letter Office.

The Hon. Secretary then reported that the Special Committee, which had been elected at the last meeting to devise some improvement and reorganisation scheme for the Society, had held four sittings, at the first of which it was decided that no decisive steps be taken until a sufficient number of efficient, experienced, and influential gentlemen, representing the Sections to be at present organised, were added to the Committee. Deputations were consequently appointed to wait upon gentlemen in the engineering and chemical profession, who succeeded to add Messrs. Mestayer, C.E., Allport, M.E., Frank Spence, John Gilchrist, I. Levinstein, P. Hart, and J. N. French (chemical manufacturers) as members to the Committee. At a subsequent sitting, it was resolved that Sections be formed—at least one additional, viz., Chemical Section; also, that a Reference Library, Reading-Room, and Museum be established, and that the meetings be so arranged that all Sections meet on different days, so that each member might attend any meeting he pleased. It was hoped that other Sections would be formed in due course. The next business of the Special Committee would now be to construct as efficient a code of regulations as could possibly be done, and that was at present under consideration; and at the next Monthly Meeting, which was also the General Half-Yearly Meeting, the Committee would be prepared to lay a complete arrangement before the Society for approval. The Committee thought it also desirable that the Society should be known under a more suitable name in future; but, as the utmost importance was attached to this consideration, no resolution had as yet been come to.

The Chairman then called upon Mr. HACKING to read his paper "*On the Ventilation of Mines.*" He said there were now about 33,000 coal mines in the United Kingdom, from which the enormous quantity of 120,000,000 tons of coal were raised annually. The depths at which these black treasures, constituting such an all-important ingredient in the wealth of this country, were stored varies very much, the deepest workings in this country being the Dakinfield and the Rosebridge collieries, near Wigan, which latter had a depth of 2418 feet, and the average temperature was about 95° F. The danger attending the getting of coal was very great; this was partly due to the peculiar position in which the miner was placed, and partly to the terrible agencies reigning at these depths. A great difficulty was to obtain an efficient supply of pure

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air, for which mechanical means had almost invariably to be adopted. A very common mode of ventilation was by means of one, two, or three shafts; at or near the bottom of one, the upcast, a fire was kept, which rarefied the air above, in consequence of which new air rushed in from the downcast, which had to make its way through the workings, and lastly to the fire.

The life of those employed in the pits was much endangered by what was called "fire-damp," which was light carburetted hydrogen (C_2H_4) mixed in certain proportions with oxygen, or, what is the same, atmospheric air. The gas itself, which issued from the pores and crevices of the coal, was inexplosive, but if atmospheric air contained more than 7½ per cent, and less than 13 per cent, the results were most terrible; if that mixture came in contact with a naked flame it would then explode. The supply of pure air was therefore required to be very ample, in order to keep the mixture below the explosive point. As a rise in the barometer indicated a decrease in the pressure of the atmosphere, a larger quantity of the gas would always be liberated when such a rise took place, and he suggested registering-barometers, which might be made to actuate an alarm as a safeguard.

Mr. HACKING was just alluding to the use of fans for ventilation, when the time arrived at which it was arranged the subject should drop, and be continued at a meeting in the ensuing session.

Mr. LYNDE then introduced the discussion on Sir William Fairbairn's new patent high-pressure boiler, which he illustrated by a good photograph and sketches on the black board, confining his remarks, however, to structural arrangements only. The boiler—which is intended to carry much higher pressures (about 150 lbs. on the square inch), as has hitherto been attempted in the Lancashire and Cornish boilers—is already tolerably well known to scientific readers, illustrations and descriptions having appeared in "The Engineer" (April 19th) and other journals. It is essentially what is technically known under "French boiler," "Woolf boiler," "Elephant boiler," or "Bouilleur boiler," with this material difference, however, that each of the two bottom tubes have internal flues containing the fire-grates, the same as a Lancashire boiler. These flues, which form an annular water-space through the whole length, are so arranged that for the purpose of cleaning, by loosening a few bolts, they may be withdrawn from the tubes, which latter are about 3 feet in diameter, communicating with one another. The entire circular shell constitutes heating surface.

Numerous questions were asked with regard to constructive detail, relative value of evaporating surface, &c., but the object of the discussion being merely to ventilate the opinion and probable experience of the members, but few questions could be satisfied, no paper having been prepared for the purpose. Various advantages and drawbacks were pointed out, but no defined decision was come to.

Votes of thanks to Mr. Hacking, Mr. Lynde, and the Chairman, terminated the proceedings.

CORRESPONDENCE.

NEW PROCESS FOR ANALYSING COMPOUND ETHERS.

To the Editor of the Chemical News.

SIR,—I think all chemists will agree with me that the publication of nearly 100 analyses, made according to a certain process, including several special control analyses showing the accuracy of the process, is something more than a mere "abstract statement that compound ethers admit of having the alcohol which they yield to alkalies measured or weighed."

The successful application to quantitative analysis of the above well-known reaction was, I believe, new in 1867; it certainly was not new in 1872.

I hope Prof. Wanklyn will not be offended if I express a belief that I have induced at least one chemist to use my process; and as we all know how ably and perseveringly this chemist brings forward any method once adopted by him, I live in the pleasing hope that my process will soon be used by chemists generally, and, at any rate, am quite contented to let the matter rest here.—I am, &c.,

A. DUPRÉ, PH.D.

MISCELLANEOUS.

Food Adulterations Act.—The Vestry of Lambeth, at its meeting on Thursday, October 10th, appointed Dr. Muter, F.C.S., to be the Public Analyst for the Borough.

New Works by Professor Galloway.—Professor Galloway, of the Royal College of Science, Dublin, has two works nearly ready for the press. The title of one will be—"How the Natural Sciences are Taught, and how they ought to be Taught; with a Scheme for rendering more efficient the Government Science Schools." The title of the other will be—"A Manual of Applied Analysis."

Dublin Exhibition.—The Executive of the Exhibition Palace have determined upon introducing popular lectures, of a sound educational character, into their programme. They have been inaugurated by Prof. Cameron, the City Analyst, who is now delivering a series of twelve lectures on "Sanitary Science." We have no doubt that, in the hands of that talented Professor, they will prove a success, more particularly as they are being well illustrated by experiments. They are delivered twice a week, on Mondays and Fridays, in the large Concert Hall. As illustrating the character of these lectures, we will give the Syllabus of the fourth lecture, delivered on Monday, the 14th inst.:—Atmospheric Dust; Organisms in the Air; The Germ Theory of Disease; The Question of Spontaneous Generation, considered in Relation to the Origin of Zymotic Diseases.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, October 7, 1872.

This number contains the following original papers and memoirs relating to chemistry:—

New Experiments Made for the Purpose of Proving that the Yeast Germ which Induces Fermentation in Grape-Juice is Derived from the Outer Skin of the Grapes.—L. Pasteur.—In this memoir the author states that oxygen alone does not excite alcoholic fermentation in saccharine liquids. The reading of this paper at the meeting of the Academy gave rise to an animated debate.

Generation of Ferments.—E. Fremy.—Replied to by MM. Dumas and Pasteur.

New Facts Relating to the Theory of Fermentation Properly so-called.—L. Pasteur.—Reserved for full translation with the observations made by M. Fremy.

Researches on Crystalline Dissociation; Alums.—P. A. Favre and C. A. Valson.—The continuation of a monograph on this subject, elucidated by several tables exhibiting results of experiments.

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Efficacy of Lightning-Conductors.—W. de Fonvielle.—A report of the author's researches on this subject, and his journey to England for the purpose of learning what experience had been gained here respecting the efficacy of lightning-rods in protecting buildings against injury from electric discharges.

Action of Borax in the Phenomena of Fermentation.—M. Béchamp.—This paper records the results of a series of experiments made to show the effect of a concentrated (at 18°) solution of borax upon yeast and upon zymase (water obtained from the washing of yeast) when in contact with a sugar solution. First series—I. Sugar-water (1 of sugar to 6 of water), 5 c.c.; yeast-water, 10 c.c.; after fifteen minutes reduction of the cupro-potassic reagent. II. Sugar-water, 5 c.c.; yeast-water, 10 c.c.; distilled water, 10 c.c.; reduction after fifteen minutes, but less strong than in I. III. Sugar-water, 5 c.c.; yeast-water, 10 c.c.; borax solution, 10 c.c.; no reduction after twenty-four hours, but evident reduction after thirty-six hours. IV. Sugar-water, 5 c.c.; yeast-water, 10 c.c.; borax solution, 20 c.c.; no reduction after forty-eight hours. From this and two other series of similar experiments, the last being made with boracic acid instead of borax, the author comes to the conclusion that the boracic acid is not the cause of the peculiar action of borax on the fermentation; while he has found that the action of bicarbonate of soda is in a manner similar to that of borax. It is incidentally observed that the addition of one drop of creosote to 100 c.c. of fermenting liquid impedes neither the fermentation nor the interversion of the sugar.

Determination of the Vegetable Substances Present in Potable and in Insalubrious Waters.—E. Monier.—This paper contains the record of the results of a series of experiments made with various kinds of previously-filtered water, titrated at a temperature of from 85° to 90° with a solution of permanganate of potassa, in order to oxidise the organic matter present in a given quantity of water, or, in other terms, to decompose a certain quantity of the permanganate. 1 litre of the water of the river Dhuys decomposes 0·5 m.g.; 1 litre (unit) of the water of the Seine, at Bercy, 4·5 m.g.; same river, at the Pont Royal (Paris), 5·7; at Clichy, near Asnieres (sewer), 11·0 to 18·0; at Saint Ouen, 7·6; at Saint Germain, 7·4; at Poissy, 5·1.

La Revue Scientifique de la France et de l'Etranger, October 5, 1872.

This number contains no original papers relating to chemistry, but we call attention to the proceedings of the Sections for physics, astronomy, geodesy, mechanics, anthropology, and engineering, of the late Bordeaux meeting of the French Association for the Advancement of Sciences.

The First Century of the Belgian Academy.—F. Papillon.—From this paper we quote the following dates of foundation of scientific societies in Europe:—Rome, 1603; Del Cimento, Firenze (Florence), 1651; L'Académie des Curieux de la Nature, 1652, at Schweinfurt, by Dr. Bausch; Royal Society, London, 1645, as a private meeting; Royal Charter, 1660; Paris, 1666: Berlin, 1741; Bruxelles, 1792.

October 12, 1872.

This number contains no original papers relating to chemistry, but we notice the following:—

Scientific Journey to Bordeaux.—E. Alglave.—Under this title valuable and interesting information is given concerning the wine-production, industry, and commerce of the district.

Annales des Mines, No. 3, 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral subjects:—

Changes which the Sulphurous Waters of Eaux-Bonnes (Département des Basses Pyrenées, France) Undergo when in Contact with a Limited Quantity of Air.—L. Martin.—The contents of this memoir may be summarised as follows:—The sulphurous water of Eaux-Bonnes (a hot spring; temperature, 31°) when admitted into reservoirs, and left there in contact with a limited supply of air, exhibits two successive reactions—the first is the rapid conversion of monosulphuret of sodium into its bisulphuret, with formation of an equivalent of silicate of soda; the second is the gradual conversion of the bisulphuret of sodium into hyposulphite of soda, by fixation of oxygen. The water in the reservoirs contains constantly all the sulphur in the condition of bisulphuret of sodium and hyposulphite of soda; no sulphuretted hydrogen is given off, nor are any higher sulphurets formed. The water contains exactly 2 equivs. of silica to 1 equiv. of sulphuret of sodium; and the above-mentioned silicate, formed by the alteration of the water when in contact with air, is a quadri-silicate. The water is conveyed to the reservoirs from some distance, and is used for bathing purposes; it contains the total quantity of sulphur present in the original water, but in the state of monosulphuret of sodium mixed with hyposulphite of soda.

Palæontological Essay on the Lower Oolite of the Limits of Southern and South-Western Central Plateau.—Dr. Bleicher.

Note on some Minerals from Chili.—E. Bertrand.—The author describes the following minerals:—Bordosite, so named from the locality in which it is found, consists of chloride of silver, and chloride and oxide of mercury; in 100 parts—AgCl, 31·23; Hg_2Cl, 45·53; HgO, 22·70. An arseniuret of copper, which is malleable and whitish-yellow coloured, contains 7·5 per cent of arsenic. Jalpaite, a sulphuret of silver and copper; in 100 parts—S, 14·02; Ag, 71·63; Cu, 13·06; Fe, 0·37.

New Silicate of Lime.—A. Piquet.—The mineral alluded to occurs at Sierra de Carija, in Spain, at a distance of 8 kilometres N. of Merida, in a quarry from which phosphate of lime is obtained. The percentical composition of this mineral is as follows:—Lime, 46·410; magnesia, 1·301; alumina, with a trace of oxide of iron, 1·561; silica, 48·356; sulphuric acid, 0·562; carbonic acid, 1·000; water, 1·111; potassa, trace. The sp. gr. of this mineral is 2·799; its formula is $2SiO_3CaO$.

Separation of Iron from Manganese.—J. P. de Rezende.—Reserved for full translation.

Annalen der Physik und Chemie, von Dr. J. C, Poggendorff, No. 9, 1872.

This number contains the following original memoirs relating to chemistry and collateral subjects:—

Experiments Made with the View to Determine the Course of the Bumerang.—W. Stille.

Mineralogical Communications.—G. vom Rath.—The eleventh portion of this monograph, this section treating on an orthite; illustrated by engravings.

Influence of the Stiffness, Mode of Fastening, and Amplitude on the Vibration of a Chord.—F. Braun.

Spectra Exhibited by Phosphuretted Hydrogen and Ammonia.—Dr. K. B. Hofmann.—Illustrated by engravings.

Evolution of Light by the Motion of Atoms.—F. Hoppe-Seyler.

Nitric Anhydride (Salpetersäures Anhydrit), and a New Hydrate of Nitric Acid.—R. Weber.—In the introduction to this paper the author refers at some length to the researches of Deville, Odet, and Vignon on the anhydrous nitric acid prepared by the action of chlorine upon dry nitrate of silver, and also to the earlier experiments of Thenard, Gay-Lussac, and others for dehydrating strong nitric acid by means of sulphuric acid. The author next describes at length a series of experiments which show that, after having prepared a concentrated nitric acid by re-distilling several times a mixture of strong nitric and concentrated sulphuric acids by the action of pure phosphoric anhydride (care being taken to keep the nitric acid cold by means of ice applied to the vessel wherein it is contained) nitric acid may be obtained in the solid anhydrous crystalline state. This substance has a sp. gr. of 1·64; it is rather prone to spontaneous decomposition, especially at a somewhat high temperature (above 10°); sulphur, phosphorus, and the readily oxidisable metals (potassium and sodium) act upon this anhydride energetically, but carbon, aluminium, zinc, cadmium, iron, nickel, titanium, copper, lead, tin, bismuth, antimony, tellurium, and thallium are quite passive with this substance; pure clean silver and palladium are not acted upon by it, but metallic arsenic and mercury are oxidised. Upon many of the organic substances this nitric anhydride acts strongly, and it combines with water in the same way as hydrosulphuric acid; it also combines with strong nitric acid, forming a peculiar hydrate, a crystalline substance, consisting of—Nitric acid, 92·31 per cent; water, 7·69. Formula, $2NO_5+1HO$.

Behaviour of some Alkaloids Towards Sugar and Sulphuric Acid.—R. Schneider.—After briefly referring to Schultze's discovery that several protein compounds and also some fatty oils exhibit a peculiar purplish colour when mixed with sugar and sulphuric acid, the author states that he has found that several alkaloids—Morphia, codeine, narcotine, and narceine—behave in a somewhat similar manner when brought into contact with sugar and sulphuric acid; but the cinchona alkaloids and strychnia, brucia, atropine, colchicine, emetine, and picrotoxine do not exhibit such a reaction; atropine assumes a rose-red colour under the same conditions; delphinine turns at first yellow, but soon becomes brown, and, upon the addition of a single drop of water, of a beautiful green colour; chelidonine treated with sugar and sulphuric acid yields a colouration somewhat like that exhibited by strychnia when treated with sulphuric acid and bichromate of potassa.

Contributions to Micro-Mineralogy.—Dr. von Lasaulx.—The second part of a monograph on this subject.

Dynamical Theory of Gases.—V. Lang.

Les Mondes, October 10, 1872.

Theory of Fermentation.—Prof. Pasteur.—From the abstract here published it appears that the celebrated *savant* has recently found that saccharine liquids (must from grapes, malt infusions, &c.) do not enter into alcoholic fermentation solely by contact with oxygen, but that the introduction of germs or dust (*poussière*) present upon the fruit of the vine is absolutely required to cause fermentation; this fact is experimentally demonstrated by the description of the mode of operating. The author also briefly alludes to some recent researches made by him, from which he draws the conclusion that two different orders of living beings exist in Nature—one of which, visible to the naked eye, requires free oxygen for sustenance; while the other, microscopically small objects, is killed by free oxygen, but lives upon that drawn from any of its combinations, carbonic acid for instance. Fruit (apples, pears, peaches, &c.) continues to live after being pulled from the trees which produced it, and, while exposed to free circulation of air, absorbs oxygen, exhales carbonic acid, and ripens. When fruit is exposed to an atmosphere of carbonic acid, this kind of life ceases, and the fruit, being prevented from absorbing oxygen, begins to assimilate oxygen from its own juice (saccharine material), the result of which is that a veritable alcoholic fermentation is set up, whereby the fruit becomes soft, and yields, on being submitted to distillation, pure alcohol, while carbonic acid is given off. This communication is as yet a preliminary one, since the researches are not yet complete.

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International Congress for Weights and Measures.—Rev. F. Moigno.—The author states that great progress has been made for the definitive adoption of the metric system as a universal international system, and that the members of the Congress agree on all really essential points.

Petites Annales de Chimie.—E. J. Maumené.—The seventh portion of this monograph, elucidated by a series of algebraical and chemical formulæ, and intended to simplify the theory of chemistry according to certain views of the author.

Caravane Universelle.—Captain Bazerque.—Under this title the author publishes an exhaustive programme of an intended scientific exploration of the different parts of the world, aided by all the means that science, industry, and commerce can supply, for the purpose of furthering friendly intercourse between different nations and tribes, as well as for geographical, meteorological, and other scientific objects.

Universal Carcel Lamp with Double Air-Draught and Compensation.—Rev. F. Moigno.—The author briefly describes a new kind of oil-lamp, constructed upon very inproved principles by A. Bernard and Co., Paris, which, when applied without reflector, gives a light equal to that of thirty standard candles, and, with reflector, a light equal to that of fifty. Having been tried as a signal-lamp on board a French man-of-war, it has been found, with a slight alteration in the burner, to yield a light distinctly visible at a distance of 10 French sea-miles = 55·555 metres = about 34·5 English statute miles.

Bulletin de la Societe Imperiale des Naturalistes de Moscou, No. 1, 1872.

It rarely happens that this periodical, which is chiefly devoted to natural history, contains an original paper relating to chemistry; we find, however, in this number the following memoir:—

Researches on the Compounds of Ilmenium and Niobium, and on the Composition of the Niobium-Containing Minerals.—R. Hermann.—This is the first part of an exhaustive monograph on this subject, elucidated by a series of formulæ, and divided into the following sections:—Preparation of $\dot{\dot{N}}b\dot{\dot{N}}b_2$ and of $\dot{\dot{I}}l\dot{\dot{I}}l_2$ from a mixture of columbite and ferro-ilmenite from Haddam; separation of the acids of niobium and ilmenium by fractional crystallisation of their potassium fluorides, and preparation of their soda salts; composition of the metallic acids contained in the Schuchardt's mineral powder; soda salts of the niobium acids; soda salts of the ilmenium acids; atomic weight of niobium; specific gravity of niobium and its atomic volume; brown niobium oxide; green niobium oxide; niobium oxide, (NbO); niobous acid, (Nb_2O_3); hyponiobic acid, (NbO_2); niobic acid, (NbO_2); niobium sulphuret, (Nb_2S_3); niobous chloride, (Nb_2Cl_3); niobous oxychloride, ($Nb_2(O+nCl)_3$); yellow niobium chloride ($NbCl_2$); niobium and fluorine; combinations of fluor-niobium and fluor-potassium; combinations of potassium-niobium-ilmenium fluoride; fluorides of niobium and sodium; combinations of fluor-niobium and ammonium fluoride; fluor-niobium and fluor-zinc; fluoride of copper and fluoride of niobium; compounds of the niobium acids with bases, viz., potassa, soda, ammonia, magnesia, oxide of iron, oxide of copper, protoxide of mercury, and oxide of silver.

Journal für Gasbeleuchtung und Wasserversorgung, Nos. 16 and 17 (double number), 1872.

Tessié du Motay's Gas-Lighting Method.—E. Mack.—From this brief report of the author's lecture we learn that important improvements have been made by B. Andreae in the preparation of oxygen, and the gas-burners have been so altered as to admit of the oxygen flowing out towards the periphery of the coal-gas flame. It further appears that at Vienna, and in other parts of the Austro-Hungarian Empire, this method of gas-lighting is also generally approved of in consequence of its small expense.

There is published in this number the detailed description, illustrated by several engraved plates, of an experimental gas-work devised by the committee of the German Association of Gas-Managers appointed to report on this subject.

Polytechnisches Journal von Dr. E. M. Dingler, first number for September, 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral subjects:—

Application of the Papin Digestor for Culinary Purposes.—Professor Junichen.—This paper treats on the use which might be made of the so-called Papin digestor under high pressure, for the purpose of boiling meat and other food. From a tabulated form added to this paper, it appears that the author's experiments prove that the time for cooking various articles of daily consumption is very much shorter when effected under strong pressure, while a great saving in fuel is also obtained.

Analysis of Crystalline and Amorphous Bottle-Glass.—Dr. H. Schwarz.—The crystalline variety (obtained from Siemens's glass-works at Dresden) contained, in 100 parts—Silica, 58·65; alumina, 7·22; peroxide of iron, 2·03; protoxide of manganese, 5·68; lime, 15·18; magnesia, 0·31; soda, 9·97; potassa, 1·03. Formula—

$$16SiO_2,2Al_2O_3,13RO.$$

Amorphous glass contained, in 100 parts—Silica, 59·33; alumina, 7·69; peroxide of iron, 1·89; protoxide of manganese, 6·30; lime, 14·13; magnesia, 0·35; soda, 9·70; potassa, 1·36. Formula—

$$17SiO_2+2Al_2O_3+13RO.$$

The sp. gr. of the crystalline glass was found to be, at 15°, 2·660; that of the amorphous, 2·648.

Venetian Mosaic Glass.—Dr. H. Schwarz.—A sample of the bright blue-coloured Mosaic glass, from Salviati's celebrated works, was found to consist, in 100 parts, of—Silica, 64·70; alumina, 2·0; peroxide of iron, 0·54; oxide of antimony, 5·92 (the semi-opacity of this glass is due to this substance); oxide of lead, 9·76; oxide of copper, 1·32; lime, 3·04; potassa, 2·05; soda, 9·98.

Decolorising Action of Animal Charcoal.—Dr. H. Schwarz.—This essay records the results of a series of experiments made with the view of ascertaining whether, by igniting bone-ash with organic substances, such as glue, size, sugar, &c., a good decolorising charcoal is formed, and also whether the spent animal black can be revivified to its former strength by a similar process. It appears from the author's extensive researches that animal black may be entirely revivified in closed vessels by ignition with organic matter, which need not be nitrogenous.

Quantity of Manganese Contained in Various Kinds of Steel.—Dr. F. Keszler.—Krupp's cast-steel contains from 0·437 to 0·438 per cent of manganese; Bochum cast-steel, from 0·312 to 0·317; Hasper steel, 0·327 to 0·332; Hörder steel, 0·167 to 0·170; Krupp's cannon steel, from 0·185 to 0·207; Ludwig's (at Berlin) manganese steel, 0·303 of manganese and 0·31 of silicium; English pig-iron (Askam and Millom, Cumberland), from 0·080 to 0·105 of manganese; piano-wire made from best Swedish iron, 0·035.

Studies for Establishing a Scientifically-Arranged Tanning Method.—A. Reimer.—The conclusion of this monograph; this portion is divided into the following sections:—On the part which the different portions of the skin play in the process of tanning (tawing) with alum and common salt; coriine with alum and common salt; the fibres of the cellular tissue; general conclusions to be drawn from the researches; tanning experiments with iron alum and chrome alum; skin and iron salts; experiments with oak tannin (quercotannic acid), general conclusion; the behaviour of skin towards tanning materials, and that of animal fibres towards dyes. The behaviour of charcoal with dyes and tanning materials belong to that class of phenomena which are designated as surface attraction *(Flächen anziehung)*.

NOTES AND QUERIES.

Transparent Cement.—I should feel greatly obliged if you would kindly tell me the ingredients used to make a liquid transparent cement to stand hot water.—Omicra.

Constituent Fatty Acids of Palm-Nut Oil.—(Reply to F. H. T. A.)—This correspondent will find the information he requires in Wagner's "Chemical Technology," recently published by Messrs. J. and A. Churchill.

Sugar-Refining.—Works on Organic Chemistry.—Would your readers kindly inform me where I can find the best information about the modern methods of sugar-refining; and what are the best works on organic chemistry, especially in regard to recent research, for a student who is well acquainted with Miller's third volume?—A. J. W.

Fusion-point of Cæsium.—(Reply to Dr. W. Hall.)—It appears that cæsium has not yet been obtained in free metallic state; an amalgam with mercury has been formed; the equivalent weight of cæsium (Cs) is 133.

TO CORRESPONDENTS.

T. Fletcher, C. T. Kingzett, L. Browne, R. Apjohn, G. Aitsworth, W. Baxter, Prof. Galloway, Prof. Henry Morton, E. Sonstadt, C.R.C. Tichborne.—Received with thanks.

Percolator.—We have often given processes for protection of wood from fire. Consult Index; also No. 669, Sept. 20th.

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THE CHEMICAL NEWS.

VOL. XXVI. No. 674.

CHEMISTRY IN INDIA.

COMPLAINTS are often made (and it must be admitted that there is some reason for them) that, on the occurrence of vacancies, chemical appointments in England are not always given to the most distinguished chemists who apply for them. What, however, should we think if the chemical chair in a first-rate hospital in London were given, not to a chemist by profession, but to a medical man who was supposed to know a little chemistry? What would be said if our friend Mr. Roberts were to be replaced at the Mint by a general medical practitioner? and if the testing of the metropolitan gas were to be handed over to some member of the medical faculty supposed to have chemical proclivities?

Such things are done in our Indian Empire, where, in addition to the many calls upon the medical profession, there falls the burden of supplying professorships of chemistry in medical colleges, chemical examinerships, assay-masterships, inspectorships of gas-works, and the like. The medical profession, although a most learned profession, cannot satisfactorily discharge all these functions. We are informed, moreover, that in one notorious instance all the offices which we have just enumerated are undertaken, not by several members of the faculty, but by one solitary medical practitioner.

The state of things in India may be imagined by such of our readers as may happen to know what a medical school used to be in times gone by, when chemistry was taught from books that stated "a stream of sulphuretted hydrogen throws down a dark green precipitate from the solution of copper." Our readers will be inclined to add that, in this instance, the green is very dark, and that it is commonly called brown or black.

It is not beyond the bounds of possibility that such a book may be in the hands of some of those medical gentlemen who have undertaken to act as chemists in India. We are in possession of details respecting the manner in which chemical operations are conducted in India, which show that, whether or not the book from which we have quoted be received as a text-book, there is imminent need of reform.

It should be known that the Indian Government set up cinchona plantations at Ootacamund, in the Madras Presidency, and at Raungbee, in Sikhim, Bengal, for the laudable purpose of supplying the fever-stricken millions of India with cheap quinine. Someone found it to their interest to lead the Madras Government to suppose that an admixture of inferior alkaloids did not cause deterioration of the quinine, and that consequently it might be hoped to supply an "amorphous quinine" at one shilling the ounce. Such hopes were, of course, delusive, and the Government are furnished with a substitute for quinine, consisting of a mixture of unbleached alkaloids, containing 18 per cent of pure quinine, 54 per cent of cinchonidine, 13 per cent of cinchonine, the remainder being colouring matter, &c. This mixture, it appears, is supplied at a cost which, according to various accounts, is from 60 to 80 per cent of that of the best quinine, and at a considerable loss on the real market value of the drug. The constitution of the Raungbee drug is reported to be even still worse, since the presence of quinine was quite cast in the shade by that of *copper* to the extent of at least *ten per cent.* But even for India this was too much, and the works have been placed under the care of a new superintendent, from whom we may hope to obtain at least a purely vegetable product.

The question may be asked, whether the chemical appointments are sufficiently well paid to induce talented chemists to seek them; and in reply it can be stated that, with a salary of £1000 to £1200 a year, and a healthy hill climate with a mean annual temperature of 54° F., India offers a fair field to every English chemist who is willing to go there.

ON THE MANUFACTURE OF PURE SULPHATE OF POTASSIUM.

By E. SONSTADT.

MOST of the sulphate of potassium known in commerce consists essentially of the double salt $3K_2SO_4+Na_2SO_4$. According to Dr. Penny's investigations, this salt, when its solution is repeatedly crystallised, affords crops of salts of variable composition, but in which "plate sulphate" and sulphate of sodium predominate. M. E. Peligot, on the other hand, in a paper, "Sur la Répartition de la Potasse et de la Soude dans les Végétaux," * proposes, as an analytical method, the separation of the sulphate of potassium and sodium by crystallisation, and in respect to plate sulphate makes the following remark:—"J'ajouterai que les sulfates doubles des potasse et de soude ne se produisent que dans des conditions exceptionelles tellement rares, que M. Des Cloizeaux a eu beaucoup de peine à s'en procurer quelques échantillons. C'est surtout lors de la cristallisation des sulfates, en présence d'une liqueur alcaline contenant du carbonate de potasse et du carbonate de soude, que ces sels ont été quelquefois obtenus. Ces conditions se trouvent réalisées dans les urines où l'on raffine les potasses provenant des salins de betteraves." M. Peligot's own results do not appear to have been subjected to the control of analysis, he contenting himself solely with reference to the crystalline form of the salts obtained, and to their character as to efflorescence in air.

About three years ago I was induced—by the difficulty I experienced in obtaining pure carbonate of potassium, free from sodium, in commerce, fit to be used in the manufacture of iodide of potassium—to experiment upon the manufacture of a pure sulphate of potassium from plate sulphate. These experiments cost me nearly a year's labour, and were conducted not only in the laboratory, upon small quantities, but also at works where a few hundredweights could be treated at a time. The statement made by Peligot, that plate sulphate can only be crystallised from an alkaline solution, is not correct. Plate sulphate crystallises from perfectly neutral solutions of sulphate of potassium, containing a certain proportion either of sulphate of sodium or of chloride of sodium. But a solution of pure plate sulphate (sodio-tripotassic sulphate), when slightly concentrated, so as to give only a very small crop of crystals on cooling, deposits pure sulphate of potassium. If the liquid is saturated when hot, and allowed to cool, the crop of crystals obtained consists chiefly of plate sulphate. By repeated crystallisations crops are obtained chiefly of potassium sulphate, containing less sodium sulphate than plate sulphate, with

* *Annales de Chimie*, December, 1867.

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occasional crops of plate sulphate and of sodium sulphate towards the last. These results, therefore, agree substantially with those obtained by Dr. Penny. I tried also "salting out" continuously from a boiling solution of plate sulphate, and found that the sodium accumulated in the salts separated during heating, but only up to a certain point. I also alternated these modes of treatment in many ways, but still unsuccessfully, so far as concerned the effective separation of the sodium from the potassium sulphate. Having failed in these attempts, I studied the mutual influence upon one another of the chlorides and sulphates of sodium and of potassium in promoting or retarding one another's solubility, and the experiments soon led to the process of purification indicated by the equation—

$$\overline{3K_2SO_4+Na_2SO_4}+2KCl=4K_2SO_4+2NaCl.$$

In practice, 664 parts plate sulphate are added to as much boiling water as will dissolve the whole; 149 parts chloride of potassium are then added to the hot solution by small portions at a time. As the chloride of potassium dissolves, pure sulphate of potassium precipitates as a crystalline powder. The liquid is allowed to cool, when more pure sulphate of potassium crystallises out. The mother-liquid is then evaporated until it becomes saturated at boiling temperature, and, on cooling, deposits another crop of pure potassic sulphate; and this process may be repeated three or four times, until the liquid becomes saturated with chloride of sodium, after which any further crops obtained would be chiefly of plate sulphate. When the muriate used in this process contains, as it usually does, a few per cents of plate sulphate, this small proportion of plate sulphate does not dissolve, but becomes mixed with the first crop of pure sulphate, and as some mother-liquor adheres and dries up upon the sulphate, the latter, in practical working under ordinary conditions, may contain as much as 3 per cent of sodium sulphate, equal to nearly 1 per cent of sodium. When the chloride potassium used is pure, as in laboratory experiments, and the sulphate obtained as described is carefully washed free from the mother-liquors, it is pure. But in practice, when—as in the manufacture of iodide of potassium—a perfectly pure potassic sulphate is required, it is better to re-crystallise the sulphate first obtained, which is then chemically pure.

These experiments have been controlled throughout by carefully-executed analyses of the salts obtained. In the earlier analyses made in the course of the investigation the sulphuric acid and the potassium were separately estimated; but in the later analyses only the sulphuric acid was estimated, and the atomic weight of the base thence deduced, in the absence of chlorine. In the sulphate of potassium that I have described as pure the atomic weight of the potassium—calculated from the sulphate of barium obtained—was usually 39·13, and rarely fluctuated more than between 39·1 and 39·2. In these analyses certain precautions must be taken,—especially that the solution of the specimen of sulphate of potassium should be *dilute*, and that the chloride of barium should be added all at once in *slight* excess, and be quickly stirred up. With these precautions the sulphate of barium precipitated is quite pure, after proper washing with pure water.

ON A MEANS OF PREVENTING EXPLOSIONS IN COAL MINES.

By JOHN A. R. NEWLANDS, F.C.S.

Diminished atmospheric pressure is frequently followed by the escape of fire-damp into the workings of a colliery. To obviate the risk incurred by such barometrical changes *I propose* that artificial means should be adopted, so as to maintain the atmospheric pressure within a given mine always at one and the same level, and also, if desired, to work under a somewhat increased atmospheric pressure. Taking the case of a mine having a downcast and an upcast shaft, the mouth of each of these should be covered over by an air-tight chamber, capable of withstanding a moderate pressure either from within or without. This air-tight chamber might be conveniently constructed of sheet-iron, provided with thick glass windows: it should also be made sufficiently large to admit of all the usual operations at the pit's mouth being conducted within it. The shaft of the engine used for raising coal would pass through the sides of this air-tight chamber, so as to move the necessary hoisting apparatus within. Connected with this air-tight chamber an air-tight room should be constructed, provided with two sliding doors, the inner door separating it from the air-tight chamber, and the outer door preventing contact with the external atmosphere. It will be seen at a glance that when the outer door of the room is shut, and the inner open, the room becomes part and parcel of the air-tight chamber, so that any truck laden with coal might be run from the air-tight chamber into the room, and then (by closing the inner door of the room and opening the outer) on to the ground surrounding the pit's mouth, without sensibly altering the pressure within the pit itself.

To produce the requisite current of air for ventilating the pit the air-tight chamber over the downcast shaft should be connected with powerful air-pumps, worked by steam, so that a continuous current of fresh air might be forced through all the workings of the pit before finally escaping through a pressure-valve from the air-tight chamber over the upcast shaft. Any required degree of ventilation, or of increased atmospheric pressure, could thus be produced within the pit. As no fire would be wanted in the upcast shaft, it would be available for hoisting coal, &c. The air supplied to the mine might, if required, be easily cooled, by compressing it in cylinders surrounded with cold water before allowing it to pass into the pit, and thus the temperature of the pit might be reduced to any extent. The air issuing from the pit should be chemically tested at stated hours, and whenever the fire-damp appeared to be increasing the men and horses should be brought up, and the air-pumps should be employed in drawing air out of the mine, so as to diminish the pressure within, and thus cause any imprisoned marsh-gas to be brought out of its hiding-place. After keeping the mine under diminished pressure for some hours, a rapid current of air should be driven through the workings, and when—by testing the air passing through the escape-valve—it was found to be nearly pure, operations could be safely recommenced.

9, Mincing Lane, E.C.,
October 21, 1872.

CHEAP SALINE DISINFECTANTS.

By SIDNEY W. RICH.

A Paper read by Mr. E. C. C. Stanford at the last meeting of the British Pharmaceutical Conference, has induced me to make the following remarks. The paper alluded to was entitled "A Cheap Disinfectant," and affected to demonstrate the superiority of chloride of calcium as a disinfectant over hydrochlorate of alumina and other saline disinfectants. Although I give no tabulated experimental results, I may state that the remarks I now make are based on the experience derived from a large amount of experimental labour devoted to a study of the relative power of these salts when applied to animal and vegetable solids and fluids, and also sewage.

The number of cheap saline disinfectants found efficacious under ordinary circumstances, may be counted on the fingers. The chlorides and sulphates of iron

aluminium, calcium, and sodium, complete the list. A few words devoted to each of these may help to give a clear idea of their respective values.

The chloride and sulphate of sodium are simply preventive, or antiseptic, although in a less degree than the free acids. They have no disinfecting or absorptive power. The extensive use of chloride of sodium (common salt), is due partly to its cheapness and convenient form, and partly to the fact that it has always been an article of commerce and domestic use.

Sulphate of calcium (gypsum) has long been used as a disinfectant, more particularly on farms and in stables. Its absorptive action is very considerable, both in respect to ammoniacal products, and, in a mechanical way, of the other products of decomposition. Owing to its slight solubility, however, it has no great action as a preventive, and the same reason confines its use to the disinfection of solid matters. It cannot be used for fluids, or allowed to enter the drains.

The value of chloride of calcium as an antiseptic is about equal to that of common salt, but it possesses, beyond, the power of absorbing the ammoniacal products of decomposition, and to that extent a disinfecting power. It has, however, no power to absorb mechanically the other products of decomposition.

The sulphate of aluminium and hydrochlorate of alumina are powerful disinfectants and antiseptics to an extent beyond any of the bodies of which we have yet spoken. As antiseptics these salts are nearly, if not quite, as efficacious as the acids themselves, while free from the objections which attach to the use of the latter. Their absorptive action is exerted on the ammoniacal products of decomposition; and also by virtue of the mechanical action of the hydrated alumina, which is precipitated immediately these salts are brought in contact with decomposing matter, or the other products of the said decomposition. The solubility and harmlessness of these salts renders their use admissible under all ordinary circumstances; while the lightness of the precipitate of alumina secures immunity from any danger of choking the drains. The hydrochlorate of alumina appears to be somewhat more powerful than the sulphate of aluminium.

The chloride and sulphate of iron have all the action of the corresponding aluminium salts, and, beyond, they possess the power of absorbing the sulphuretted products of decomposition. This latter fact places these salts at the top of the list in respect to efficacy. There are, however, some objections to the use of these salts, the principal being that when used in large quantities for ordinary purposes, the iron itself is likely to be injurious to the vegetation with which the fluid or other matter may ultimately come in contact.

Apart from the question of price, the conclusion to be derived from the above observations is manifestly as follows. That the greatest efficacy and general applicability will be found in a solution containing hydrochlorate of alumina with a small quantity of chloride of iron. The hydrochlorate of alumina will serve to do the general work of a disinfectant and antiseptic, while the iron salt will absorb the sulphuretted compounds which arise from the decomposition of some kinds of organic matter.

The chloride of calcium is the cheapest, inasmuch as it is a waste product in all alkali works. In this particular, hydrochlorate of alumina will, however, be able to compare favourably in the future as the result of late improvements in the manufacture of alum will be to cause the manufacture of large quantities as a waste product.

In recommending chloride of calcium as a disinfectant, Mr. Stanford recommends that the solution should contain 25 per cent of the solid salt, acidified with 12 per cent of hydrochloric acid. Certainly, such a solution would have a considerable disinfecting power, but most chemists would attribute this to the hydrochloric acid. Moreover, a solution containing 12 per cent of hydrochloric acid would be a very disagreeable fluid for ordinary purposes.

THE EARTH SALTS OF BELLARY.

By EDWARD NICHOLSON,
Assistant Surgeon, R.A.; Analyst of Waters, Mysore, Northern and Ceded Districts.

THE soil of the Ceded Districts yields three saline products —salt, nitre, and soda. I have lately examined the first two of these in the course of my investigations on the peculiar salinity of wells sunk in black cotton soil.

Salt.

Any person who has been in Bellary must have remarked mounds of black cotton soil here and there about the outskirts of the cantonment. These mounds are raised for the purpose of being worked for earth salt; when exhausted they are abandoned, and become gradually levelled by the scanty rain of years. They are generally situated not far from the lines of drainage of the country at any convenient spot where the soil is saline, and water can be easily obtained. Patches of the most saline earth, tested in a simple manner by application to the tongue, are dug up and heaped in a mound 10 or 12 feet high; at different levels of the mound funnels are excavated and lined with beaten earth, and the loose earth being placed in these is gradually exhausted by repeated washings. The water having been sufficiently charged with salts in its passage through the different funnels, is run on to a level floor of rammed earth surrounded by a low rim. Under the influence of Bellary sun, evaporation is effected in a few days, and a residue of salt is left. This is piled in heaps for any moisture (bittern) to drain off, and when dry, it is sold to the villagers for domestic consumption. The wholesale price is about 30 seers (measure) for a rupee; it is retailed at about eight cash per seer (a penny per quart), which is half the price of sea-salt. It is not usually sold in cantonment, as it is never used by the population of sepoys, camp followers, and other people not belonging to this part of the country, its use seems to be entirely confined to the villagers.

Bitter flavour is sometimes alleged by the camp population as the reason why this salt is not used, but I am inclined to think that the dislike is more caused by prejudice against the source of the salt.

I have examined several specimens of earth salt, and found them to differ very widely in composition, some being of considerable purity, whilst others contained as little as 44 per cent of sodium chloride. In some cases I found that the fresh salt consisted of perfectly pure and white crystals of sodium chloride bathed in a mother-liquor of deliquescent calcium and magnesium salts, principally nitrates with some chlorides and sulphates. Either washed with cold water and then dried, or pressed between folds of blotting paper, the crystals were much purer and whiter than any sea-salt; but before this cleansing, a distinctly bitter flavour was imparted by the mother-liquor.

One specimen was brought to me by a man who engaged largely in the manufacture, as a fair specimen of the salt produced in his district. This I subjected to complete analysis. When air-dried it still contained 3 per cent of moisture; it was of slight alkaline reaction, clean, but of white effloresced appearance without any regular crystals. Exsiccated, it had the following composition per cent:—

Sodium chloride	44·50
Sodium sulphate	49·30
Magnesium sulphate	4·93
Magnesium nitrate	0·24
Magnesium carbonate	0·35
Calcium carbonate	0·70
Insoluble (sand, clay, &c.)	0·45
	100·47

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A person consuming daily the moderate amount of a quarter of an ounce of this salt would take along with the real salt a quantity of sodium and magnesium sulphates (anhydrous), equal to 121 grains of Glauber's salt, and 12 grains of Epsom salt. I do not think that difference of taste would warn people against this. Magnesium chloride, nitrate, and sulphate are very bitter, so also are calcium chloride and nitrate, and the presence of these in the mother-liquor adherent to crystals of salt would give a decided unpleasant flavour. This is not, however, the case with sodium sulphate; its taste is not very disagreeable, and in this sample it seemed to be entirely concealed by that of the chloride. A slightly bitter after-taste arose from the magnesium salts present.

The purification of the different samples of earth salt would have to be done in various ways, differing according to their respective composition. Those which consisted of pure salt coated with the deliquescent earthy nitrates and chlorides, could easily be purified by simple washing with a little cold water; but this would not do in the case of the sample containing a large quantity of sodium sulphate. If the quantity of sodium sulphate and other foreign salts did not exceed one quarter, the best plan would be to lixiviate the salt gradually with an equal quantity of hot water. But when, as in the case of the above sample, the quantity of sodium sulphate amounts to fully one-half, the purification would be best done in the following manner. Wash the salt with a very small quantity of hot water to remove magnesian and other deliquescent salts; then, the salt having cooled, add to it an equal quantity of the coldest water; the sodium chloride will dissolve to the extent of 40 parts in 100 of water, whilst the sodium sulphate will dissolve much more slowly and in a quantity inversely proportionate to the coldness of the water. 100 parts of water take up 10 parts at 60° F., 15 parts at 68°, and 20 parts at 77°. The colder the water the less sodium sulphate will be taken up; the residue will consist entirely of this salt, whilst the chloride can be recovered by boiling, in a much purer condition. The residue might possibly be utilised for the manufacture of carbonate of soda by calcination with kunkur and charcoal.*

The brackishness imparted by this salt to many of the wells sunk in the black cotton soil is different in character from that arising in consequence of "previous sewage contamination." In Bangalore, where, owing to the porousness of the soil, whole districts of the station are saturated with the mineral products of excrementitious infiltration, the salts found are quite distinct; sodium chloride, earthy (calcium and magnesium) chlorides and nitrates appeared in quantities varying from 50 to 300 centigrammes per litre, but I never found the slightest increase in the small amount of sulphates normal in the Bangalore subsoil water. Whatever the character of the water they always remained low—about 0·4 to 0·6 centigramme per litre. In Bellary, out of the influence of the black cotton soil, the subsoil water does not differ materially from that of Bangalore, and like it, contains a very small proportion of sulphuric acid; but the quantity of this constituent increases rapidly as the wells approach the black cotton soil—10 to 30 centigrammes are not uncommon, and one well yielded as much as 153 centigrammes (equal to 227 centigrammes per litre, or 159 grains per gallon of sodium sulphate).

The sulphates are accompanied by a proportionate quantity of chlorides, and invariably by some nitrates. The latter are in lesser proportion, as it is not usual in the water of uncontaminated soils for the amount to exceed 2 centigrammes per litre. These saline waters are not very hard, the greater part of the salts being alkaline (sodic) rather than earthy. Sodium chloride and sulphate are the principal salts present, earthy chlorides, sulphates, and nitrates, being in considerably smaller proportion. The distinguishing characters between these saline waters and waters charged with the mineral traces of sewage may be thus tabulated:—

Saline Water from Black Cotton Soil.	Saline Water from Polluted Soil.
Much chlorine— 40-100 c.grm. per litre.	Much chlorine— 20-120 c.grm. per litre.
Much sulphuric acid— 10-150 c.grm. per litre.	Little sulphuric acid— Under 1 c.grm. per litre.
Nitric acid variable— 1-5 c.grm. per litre (rarely more).	Nitric acid large if not exposed to air and vegetation— 10-30 c.grm. per litre.
"Permanent" earthy salts present; never greater than "removable" earthy salts.*	Very much permanent earthy salts; generally largely in excess of removable earthy salts.

In many cases the liquor extracted by the salt makers from the black cotton soil approaches very closely to sea-water in its composition, only differing materially by the presence of nitrates; the product of evaporation is hardly distinguishable from bay salt. The occurrence of sodium sulphate would seem to distinguish the mixture of salts from that found in sea-water, as that substance does not exist in sea-water; but its presence in earth washings is readily explained when we remember that any sodium silicate or carbonate existing in the soil would decompose the earthy sulphates of marine origin; insoluble earthy silicates or carbonates and soluble sodium sulphate being the result. And it is to be remarked that the soils which produce salt do not produce soda, the presence of the earthy sulphates that accompany the salt preventing apparently the soda being produced as it otherwise would be.

A peculiarity of the marine deposits (as I believe they are) diffused through the black cotton soil country is their tendency to accumulate in the lines of drainage; not only about dry watercourses at the low level of valleys, but also nearer to the larger drainage system of the country. I am informed that, in some parts of the Ceded Districts, wells near to rivers give, as a rule, brackish water, quite contrarily to what one would expect. The reason of this is probably to be found in the very partial washing which the soil undergoes from the scanty rainfall. The salts are washed from the soil of the higher tracts of country, but by the time the subsoil drainage water has percolated to the lower parts of the valleys, it is much nearer to the surface and the cessation of rain with the force of evaporation causes the salts to stop on their journey towards the sea.

In connection with this subject two points may be noted:—

(1). These sulphated waters readily evolve sulphuretted hydrogen when in contact with wood. Sojourn in a tub for one night causes most Bellary water to smell offensively by the next morning. This should not be confounded with "putridity," as it too often is in sanitary documents.

(2). The sulphates and chlorides appear to be inimical to vegetable life when repeated irrigation has caused garden soil to become charged with these salts; but in more moderate quantity the sulphates have a beneficial effect on plants requiring much sulphur, leguminous and cruciferous plants for instance. Bellary onions are well known for their excellence and abundance; it is possible that they flourish in consequence of being so freely supplied with the sulphur necessary for the formation of their essential oil.

* One cannot, however, but be astonished that the manufacture of this culinary salt should be continued, in spite of its impurity and the small pecuniary advantage in its use, now that the railway passes through the Ceded Districts. I believe that Government loses a large amount of revenue owing to the substitution of this earth salt for sea salt.

* I use these terms derived from the soap-test purely for convenience, meaning by "removable" earthy salts the carbonates and silicates of calcium and magnesium correctly ascertained. Boiling does not remove them, however; a water may be entirely free from "permanent" earthy salts (chlorides, sulphates, nitrates), yet show after boiling considerable permanent hardness. Evaporation to dryness and re-solution, give far more correct results.

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Nitre.

Nitrates are invariably found in well-waters derived from subsoils of decomposed felspar or of clay. Ammonia, whether that normally found in the atmosphere, or that produced by organic decay, becomes oxidised when in contact with porous soil, and in presence of bases with weak acids—such as silicates and carbonates—it changes into nitric acid, and expels the weaker acid. As there are few soils that do not contain silicates and carbonates of either potassium, sodium, magnesium, or calcium the presence of nitrates is nearly universal, and we would naturally expect to find them in the washings of the salt-mounds. The filtration of water through soil containing silicates or carbonates would generate nitrates even if none were present originally. I found as much as 1·5 per cent of nitric acid in the solid residue of a sample of earth washings, a quantity equal to 176 centigrammes per litre of the fluid; and the moisture adhering to the crystals of salts subsequently obtained was highly nitrous. The nitrates present in the earth-washings are always the deliquescent nitrates of calcium and magnesium; the sodium salt being excluded in consequence of earthy sulphates and chlorides having already decomposed any sodium silicate or carbonate that would otherwise have been available for the saturation of nitric acid as it is formed. Potassium being comparatively of rare occurrence in these soils is excluded also from combination as nitrate. The nitrates existing in every sample of earth-washings that I have examined are consequently wasted; while if the mother-liquor of the salt crystals were treated with wood ashes, or other convenient source of potash, the earthy metals would be replaced by potassium, and nitre would be obtained. The quantity, would, it is true, be not more than 2 or 3 per cent of the common salt obtained.

The nearest place where I could find nitre to be regularly made was at Sirragirri, about 20 miles north of Bellary. From the account given me of the process by the nitre maker of Sirragirri, it would appear that earthy nitrates are never utilised, and that soil containing potassium nitrate already formed is the only kind worked. To obtain nitre at once in this condition, in a country where potassium salts are rare in the soil,* the nitre maker must confine his operations to soils in the neighbourhood of villages, selecting those spots where, from infiltration of urine, from the drainage of cattle sheds, or from the vicinity of ash heaps, the earth has become artificially supplied with potash. Considering that Indians generally use the manufacturing processes which are best adapted to circumstances, and which, though rude, are quite as profitable to them as the more ingenious but more expensive processes of European industry, I am rather surprised that the addition of potash to earth-washings containing earthy nitrates is not practised in India as it is in Europe. The earth-washings are allowed to evaporate as in the manufacture of salt, and any earthy nitrates are lost in the mother-liquor. The nitre is obtained tolerably clean, in small prismatic crystals mixed with the cubic crystals of common salt; this impurity varies from 6 to 20 per cent, or more. If required refined, it is purified by solution and re-crystallisation, a most wasteful process under the circumstances, as about 30 per cent of the nitre is lost.

The impure nitre is sold at one rupee per maund of 24 lbs.; when purified, the same quantity costs one rupee twelve annas. This very low price is, I think, occasioned by the nitre being too impure for shipment, and the manufacturers are not acquainted with the processes of refining economically. The nitre might be bought and refined at a total cost of not more than 12s. per cwt., it being worth 28s. to 30s. at home. Ignorance of economical refining processes affords the only explanation of the low prices obtained for an article of such value. To refine it economically it would be necessary to accumulate a large quantity; mix it well, and determine from an analysis of a sample the process to be adopted for its purification. The process applicable to a nitre containing only 5 per cent of impurity would be quite inapplicable to another sample containing 40 per cent of impurity.

* The greater part of the soil of India is produced by decomposition of metamorphic rocks,—gneiss, basalt, trap,—the felspar contained in these are principally soda felspars.

Soda.

I have not been able to meet with any instance of this salt being produced near Bellary; that sold in the Ceded Districts is made, I believe, near Cuddapah. The sodium carbonate, of which the impure soda principally consists, is the result of the decomposition of sodium silicate by atmospheric carbonic acid. Silicic and carbonic acids are about of equal strength, and it entirely depends on circumstances which acid can expel the other from its combinations. Silicic acid expels carbonic acid from solutions, whilst carbonic acid acting in excess, and for long periods of time, expels silicic acid from solid silicates. In parts where the soda is produced it is found principally as an efflorescence on the surface, the sodium silicate of the soil having evidently been decomposed by atmospheric carbonic acid. Its presence is incompatible with that of earthly chlorides, sulphates and nitrates; and as these are constantly found accompanying the salt and nitre yielded by black cotton soil, it is evident that the production of salt or nitre excludes that of soda.

Natural sodium carbonate does not appear to be produced in India to any considerable extent, perhaps little in excess of the limited requirements of washermen.*

The main features of the production of these earth salts may be thus summarised:—

Salt is derived from marine deposits in the black cotton soil. It may be mixed with the following impurities:—

(1). Marine earthy salts, principally magnesium chloride and sulphate.

(2). Sodium sulphate, produced by the decomposition of marine sulphates by sodium silicate.

(3). Nitrates, principally of magnesium and calcium.

Nitre does not accompany salt as such (as potash nitre), but indirectly as earthy nitrates. Potash nitre can only be obtained from soils to which potassium salts have been added accidentally or purposely. Soils containing the nitrified products of decayed animal matters are alone profitable to work; even in these there is great loss unless potassium salts be added.

Soda is produced in soils by the action of carbonic acid on the sodium silicate of decomposed felspar rocks. Both the carbonate and the silicate of sodium being decomposed by the soluble earthy salts which invariably accompany salt and nitre, soils yielding the latter salts cannot yield soda.

* For many years there has been advertised a machine warranted to produce ice by the aid of two salts indigenous to India, and procurable everywhere at a cheap rate. The two salts are sal-ammoniac and carbonate of soda. Most possessors of these frigefactive engines can give doleful accounts of their searches in the bazar after the last named salt.

FLUORESCENT RELATIONS OF ANTHRACENE AND CHRYSOGEN.

By HENRY MORTON, Ph.D.,
President of the Stevens Institute of Technology.

In the course of an investigation of the fluorescent spectra of certain organic and inorganic substances, some of the results of which have just been anticipated by Becquerel in a memoir presented to the French Academy (see *Comptes Rendus*, vol. lxxv., p. 296), I was led to study pretty thoroughly the properties of anthracene in this connection, and have arrived at certain results which are new, and possibly of some moment in their bearing upon

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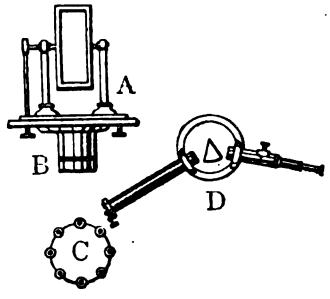
the discrimination between that substance and some of the associated bodies.

In the first place, it should be noticed that anthracene is ordinarily procurable in several forms, either as—(1) a dark olive-green crystalline fused mass or (2) a green-grey powder, both these being its crude state; (3) as a light brown flaky powder, in which form it is imported from the best German chemical manufacturers under the title of chemically pure anthracene; (4) as a snow-like powder with a faint yellow tinge, in which condition it can readily be obtained by distillation in a current of air; or (5), lastly, as a mass of pearly scales, also with a tinge of yellow, in which form it is readily obtained by crystallisation on cooling from a solution in alcohol saturated at the boiling-point.

In any of these forms, when placed in the path of a beam of sunlight (see Fig. 1), condensed by a lens, and passed through a tank containing ammonio-sulphate of

Fig. 1.



copper in solution, and then examined by a spectroscope, anthracene yields a spectrum (of which Fig. 2 is a rough drawing) consisting of four bright bands, separated by dimmer, but not absolutely dark, spaces. The first of these bands is of red colour, the second of orange and yellow, and the other two green.

The dark space dividing the red from the orange is narrow and faint compared with the others, which, even in the lightest form of the material, as mentioned above, are strongly marked. The striking persistence of this fluorescent spectrum, in face of the great change in optical appearance of the substance itself, is curious, and furnishes a ready means of recognising this body under the endless variety of tints and structural conditions which it assumes.

In his admirable work, entitled "La Lumiere" (vol. i., p. 382), Becquerel notices, among other "phosphorescent" bodies, an "hydrocarbon having the colour of the uranium salts, and obtained from Fritzsche." He also gives the spectrum of this substance, as seen when "excited" in his phosphoroscope. No measurements are furnished, but the bands are shown in their relation to the Fraünhofer lines, and in this regard the correspondence with the spectrum shown in Fig. 1 is so close that I should have little hesitation from this alone in believing that Becquerel's hydrocarbon was anthracene; but when it is remembered that anthracene, under the name of photene, was first studied by Fritzsche, the inference becomes much stronger.

While writing the above, I received the last number of *Poggendorff's Annalen* (1872, No. 7), and there find the remarks by E. Hagenbach on the above subject, in which he states that his examination of a minute fragment of photene or anthracene obtained from Wöhler leads him to the conclusion that it differs from that used by Becquerel.

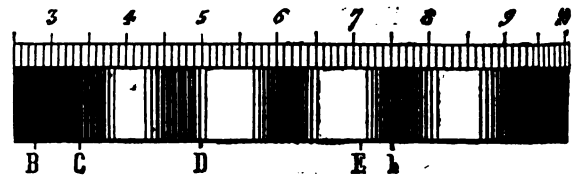
As, however, I find a perfect agreement in the position of these bands in specimens of anthracene obtained from several foreign and American sources, and in all sorts of conditions resulting from various treatment, it seems to *me clear that* Becquerel's material is identical with what *is now known in commerce as* anthracene.

We naturally inquire, in the next place, whether this spectrum is due to pure anthracene or to some intimately associated impurity. To settle this it was necessary to obtain some chemically pure anthracene.

After many trials, I found that, among all the processes recommended by Kopp in his excellent article in the *Moniteur Scientifique-Quesneville* (1871, p. 536), none would produce a body pure enough to bear this delicate optical test, except that of exposing the hot solution to sunlight. I, however, used the solution in alcohol with, I think, better results than benzine, which is recommended by him, as in this case no notable amount of para-anthracene was formed. The substance thus obtained yielded a pretty blue fluorescence, but one much less brilliant than that of the partially pure variety, and this, when examined with the spectroscope, showed *a continuous spectrum*.

In all its general properties, this substance agreed with that prepared by distillation and repeated crystal-

Fig. 2.



lisation from hot alcohol, being like it made up of pearly-white scales, reacting chemically as pure anthracene should. In fact, the two forms are not to be distinguished except by this optical test.

It can therefore, I think, be safely concluded that pure anthracene does not give a banded spectrum by fluorescence, and that the spectra given by Becquerel and Hagenbach, as well as that shown in Fig. 1, belong to some associated body.

Before leaving this part of the subject, I would remark that, if a solution of anthracene in hot alcohol is allowed to cool to about 80° F., it will deposit a crop of crystals, which seem to carry down nearly all the fluorescent colouring matter, so that those deposited by cooling it further to 32° F. will be far lighter. The special state of aggregation also has a marked effect upon the intensity of the fluorescence; the flakes deposited from a solution in cooling, or the crystals obtained by evaporation, being much more active in this respect than those obtained by distillation, or rather sublimation. A white powder, obtained by adding water to the alcoholic solution, has also in some cases no easily appreciable fluorescence, and the first specimen which I prepared by exposure to sunlight had so little fluorescence that I described it at first as equal only to that shown by white paper. Other specimens, however, similarly prepared, gave the delicate blue fluorescence above mentioned.

Considering, next, what was the origin of the fluorescent light which gave the banded spectrum, we find that Fritzsche gives the name chrysogen to a yellow substance accompanying anthracene, which is soluble in ether, is destroyed by exposure of its hot benzole solution to sunlight, and of which a quantity too small for analysis was isolated by him (*Comptes Rendus*, vol. liv., p. 910).

This is, without doubt, the substance whose spectrum is found in all the forms of anthracene first enumerated, and in the material examined by Becquerel.

In addition to the *fluorescent* spectrum furnished by impure anthracene, or rather, we should say, chrysogen, it gives a very characteristic absorption-spectrum, showing two strongly-marked bands, a less defined one, and extinction of all rays above 13·8 (see Fig. 3)

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btain this, it is best to distil some of the crude nthracene in a current of air (see CHEMICAL NEWS, v., p. 165) at a rather high temperature, so as a yellow product, then to wash this thoroughly old alcohol, which removes a brownish yellow il, yielding no absorption-bands, and little, if at all, cent.

material now left may be spread on filter-paper amined by transmitted blue light, as shown in ; or it may be mixed with melted paraffin and

FIG. 3.

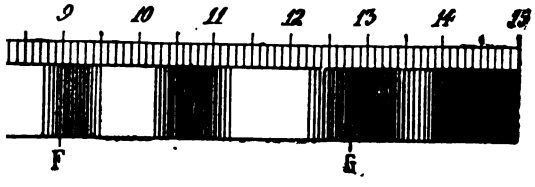
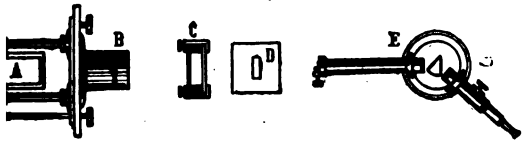


FIG. 4.



on glass, or fused between slips of mica or glass, mined in the same way. The absorption-spectrum in Fig. 2 is then seen.

band near 9 of scale, or Fraunhofer's line F, hes on the upper bright band of the fluorescent n, so that in certain methods of observation, when ion and fluorescence are observed at once, this band seems to be narrower than the one next which, however, is not the case in fact.

band about 13 of the scale, or Fraünhofer's is not well defined, and is connected by a shade e point about 14, where the absorption becomes

imported chemically pure (?) anthracene, washed

FIG. 5.

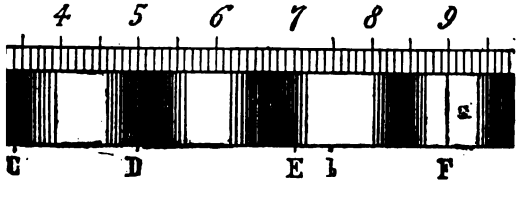
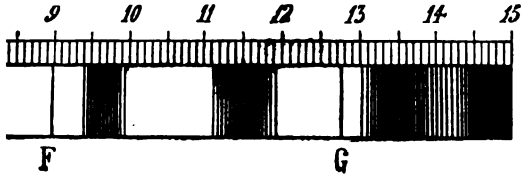


FIG. 6.



cohol to remove the above mentioned brown nswers very well for this observation.

er of the above two last forms of anthracene are i in benzole (coal-tar naptha) a yellowish solution ed, which fluoresces with a brilliant green colour s the spectrum shown in Fig. 5, which it will be comparison with Fig. 1 differs from that of the stance only in the displacement of all the bands towards the violet end of the spectrum. The same holds good with the absorption-bands, as will be seen by comparing Fig. 6, which shows the absorption spectrum of a solution of impure anthracene (*i.e.*, chrysogen) in Benzole.

This is an action which has never, I believe, been observed before. I have a partial parallel found in a few of the uranium salts which I have examined with this view, but it is not noted by Stokes, Becquerel, or Hagenbach.*

It does not, however, stand alone. Some months since, in a Paper read before the American Institute in New York, and the Franklin Institute Philadelphia (see *Journal of the Franklin Institute* vol. lxiii., p. 296), I announced under the name Viridin a solid substance of remarkable fluorescent properties, and yielding a spectrum closely allied to that of anthracene.

Subsequent experiment has confirmed these results, and has also demonstrated that, like ordinary anthracene, this substance is a mixture of a coloured body yielding a banded spectrum, which, to avoid circumlocution, I would call Thallene, in allusion to the bright green bands of its fluorescent spectrum, as well as to the general character of its fluorescent light; and a white body crystallising in spicules, which I would call Petrollucene, in allusion to its origin, fluorescence, and resemblance to anthracene, from which it differs, however, in crystalline form, melting-point (this being in its case about 700° F.), and in solubility.

With this mixed body, as with the anthracene above described, the spectrum of fluorescence, as also that of absorption, has all its bands displaced towards the more refrangible part of the spectrum, without other change by solution in various solvents.

In the case of the oxalate of uranium the *absorption-bands* are displaced downwards in the spectrum by solution. When a pure spectrum is thrown on a screen covered with either of the above mentioned hydrocarbons or on a tank filled with their solution, a series of maxima and minima of fluorescence are observed which in each case coincide with the absorption-bands of the same body, a maximum of fluorescence coinciding with a maximum of absorption. A relation similar to this was pointed out by Stokes in the case of leaf-green solution, *Phil. Trans.* 1852, Part II., p. 491, and in canary glass and uranium nitrate in a general way, *Phil. Trans.* 1852, Part II., p. 497, and p. 517. Hagenbach has also noticed this relation in a number of the substances which he has examined, and also points out the *absence* of any connection between the numerous absorption-bands seen in nitrate of uranium and the fluorescent maximum of that body.

In conclusion I have to thank my friend Dr. G. F. Barker for valuable aid through his familiarity with the chemical literature of the day, and for aiding me in obtaining a fresh supply of the new material when a difficulty in this direction had arisen; also to Mr. John Truax, of Pittsburgh, in the same connection, also to Mr. J. C. F. Chever, the Superintendent of the works of Messrs. Page, Kidder, and Fletcher, at Bull's Ferry, N.J., for some specimens of unusually fine crude anthracene prepared at those works, from which most of my preparations of that body have been made. Also my assistant, Mr. W. E. Geyer, and Messrs. P. P. Poinier and A. H. G. Sorge, students in the Institute, for various assistance in connection with these observations.

* After the above was written and had been published in the *American Chemist* of September for some weeks I received *Poggendorff's Annalen* in which I find that Hagenbach had just noticed a *similar* action in a few bodies dissolved in different menstrua.

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CORRESPONDENCE.

THE UTILITY OF ODOURS TO PLANTS IN RELATION TO RADIANT HEAT.

To the Editor of the Chemical News.

Sir—The more closely and philosophically the works of Nature are studied, the stronger, generally speaking, is the conviction that, in every department of them, a principle of utility has been strictly and uniformly kept in view, and that accordingly, where the enquirer might least expect to discover it, this principle may often be indisputably traced.

A very apposite and striking illustration of this scientific truth is found, I think, in the relation of the odours of flowers, and of other fragrant organs of plants, to radiant heat; and as the subject is one which has not hitherto, I believe, been especially noticed, I may perhaps be permitted to draw attention to it in your valuable pages. In order, however, that these brief remarks may be fully understood, it is necessary to refer to the important and interesting discoveries of Prof. Tyndall, in thermal radiation, a *résumé* of which he delivered before the University of Cambridge, in the Rede Lecture for 1865.

He found then that odours or perfumes, in common with many gases and vapours, especially that of water, have the remarkable property of absorbing large quantities of radiant heat, and particularly the obscure or non-luminous rays, such as those emitted by the earth. Thus he has shown, in his table of the "Absorption of Perfumes," that otto of roses absorbs 37 times as much radiant heat as perfectly dry air, the oil of lavender 60 times as much, that of rosemary 74 times as much, while that of aniseed absorbs no less than 372 times as much.

And, turning from perfumes to vapours, he observes, "that probably from 10 to 15 per cent of the heat radiated by the earth is absorbed within 10 feet of the earth's surface," although the aqueous vapour contained in the atmosphere amounts to only ½ per cent of the whole mass of the air. This aqueous vapour, thus becoming heated, "wraps," as he says, "the earth like a warm garment, and protects it from the deadly chill it would otherwise sustain;" for it must be remembered that radiation and absorption always correspond, and that, accordingly, in the case of gases and vapours, the best absorbers are, at the same time, the best radiators. The same remark applies equally to odours or perfumes; and thus we are brought back to the especial subject of these observations.

Let us, then, consider the case of a tender plant, such as a rose in a healthy growing state, and emitting copiously from its lovely blossoms the unrivalled essential oil to which it owes its fragrance, and let us ask—What is the office which, quite independently of the assumed very subordinate one of regaling the olfactory sense in man, this plentiful and continual discharge of aromatic matter into the atmosphere is intended to fulfil? The answer to this question follows naturally, I think, from the preceding facts; for if, as Prof. Tyndall has proved, the odour of the oil of roses absorbs 37 times more radiant heat than dry air, and radiates in the like degree, we may confidently infer that the plant, in thus generating around it a warm atmosphere of odour, is ministering to its wants by virtually providing for itself a more congenial temperature than it could otherwise enjoy. And if we pass from individual instances, and consider generally that the flowers of plants are especially the seat of the odours they emit,—and, moreover, that the production of seed is essentially dependent upon the flowers, not only physiologically, but in all their physical relations, particularly that of temperature,—we cannot fail, I think, to conclude that the envelopes of aroma, if I may so speak, which surround the flowers must materially aid in the maturation and protection of the seed.

Many fruits also, such as the lemon and orange, so remarkable for their fragrance, may have their ripening hastened by the essential oil that they so freely give forth; this oil, in the case of the lemon, absorbing, according to Prof. Tyndall's experiments, 65 times as much radiant heat as dry air.

Even, too, in the case of some of the flowerless plants, the ferns for example, the odour that the fronds exhale, and which is very characteristic in this numerous and interesting order, may serve as a protection against cold, and thus also indirectly aid the fertilisation of the spores.

It would be easy to present further illustrations of the views which, in a very imperfect form, I have submitted to your readers; but having, I fear, already trespassed upon your columns, I must leave them to follow out the subject in all its instructive and important relations.—I am, &c.,

W. H. Olley.

Stoke Newington.

CONSTITUTION OF MATTER.

To the Editor of the Chemical News.

Sir,—I beg to express my thanks to your correspondent, J. W., for pointing out the inaccuracy of two statements in my paper. Both were clerical errors:—Methyl should have been written $(CH_3)_2$, not CH_3, and "propionic aldehyd" should have been substituted for "propylic alcohol."

But the two particular cases of isomerism that I cited are not necessary to substantiate my illustrations of the oneness of matter; others would do as well. It is evident that Mr. Sutton has confounded matter and force in several instances; but let us proceed to examine his objections to my arguments. He considers the analogous properties of chlorine, bromine, and iodine, and other groups of bodies, to constitute no proof of the mono-elemental theory. If it is not a proof, it is at least an argument in its favour; and if I can show that the atomic theory supports the mono-elemental one, it will be almost a proof under Mr. Sutton's view of matter, for he says the atomic theory is opposed to unity of matter. Now Mr. S.'s view is embraced in the following passage:—"We have no doubt that the only difference between the so-called elements (hydrogen, oxygen, &c.) is the difference of their respective atomic weights, and *of course* corresponding atomic sizes;" but nickel and cobalt have the same atomic weights and sizes,—therefore there is no difference between the two, so that nickel is cobalt and cobalt is nickel, and yet Mr. Sutton argues that in their natures they are different. It really seems as though he were ignorant of the existence of groups which, regarded under his favourite theory, viz., the atomic theory, are isometric,—that is, have the same atomic weights and sizes or volumes.

Mr. Sutton next writes—"And if this is the case, the ultimate atoms themselves (whether of hydrogen, oxygen, or any other element) must be all of the same and only elemental matter, because, not being themselves composed of atoms, no difference in the nature of their substance can exist." The meaning of this is apparently "buried" in "profound obscurity;"—if atoms are not composed of atoms, what are they composed of?

I confess I fail to see into what error Mr. Sutton affirms I have fallen, but it is obvious that he has made a serious error by saying "the withdrawal of the forces cannot alter the atomic sizes." If this be a fact it is most important, but I am unwilling to accept it as such until I know by what experiments or reasoning he has demonstrated it. Would it not be wiser to say the atomic size is an effect of force? For if it is not, then the atomic volume of water at 100° C. would be the same as at 0° C.—yet even Mr. Sutton would see the untruth of this. Again, if "the withdrawal of the forces cannot alter the atomic sizes," why should the atomic volume of any one

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element or body be different from that of any other? Or (to view the matter in another light) if matter cannot exist without force, then force must exert an influence over matter under any circumstances,—therefore the size or volume of atoms is influenced by force.

Your correspondent is apparently delighted to find a lack of faith on my part in what he is pleased to call "my philosophy," which includes the belief that a "compound is formed by a uniting force between two or more such differently operated upon portions of elemental matter," because I confess that in potassic iodide the iodine exists in its own nature. Does not Mr. Sutton see that the whole gist of my paper was to prove that iodine in its nature is the same as hydrogen, or any other so-called element, the different properties arising from each of the different portions of elemental matter being influenced by the forces in peculiar ways? and, if so, where has he discovered my lack of faith? The fact is that he based all his arguments upon atomic volumes and weights, which subject in his hands, as opposed to the mono-elemental theory, entirely broke down, and, as a necessary consequence, the arguments founded upon it.—I am, &c.,

CHAS. T. KINGZETT.

Liverpool, October 16, 1872.

ITALIAN CHEMICAL MANUALS.

To the Editor of the Chemical News.

SIR,—The statement recently circulated as to the non-existence of chemical manuals in the Italian language is incorrect, as the following list of such works amply proves.—I am, &c.,

A. H. C.

PIRIA, R., "Lezioni Elementari di Chimica Organica." Turin, 1870.
TASSINARI, P., "Avviamento allo Studio della Chimica." Pisa and Turin.
TASSINARI, P., "Manuale di Chimica Inorganica." Pisa.
OROSI, "Manuale di Chimica Analitica Inorganica." 1871.
SCIVOLETO, P., "Principi di Chimica Analitica." Naples, 1869.
SELMI, A., "Chimica applicata all' Agricoltura." Milan, 1871.
MANCUSO, G., "Trattato di Chimica Generale e Descrittiva." Palermo, 1872.
ANTONELLI, "Trattato di Chimica Moderne." Modena, 1865.
BOUZANI, F., "Elementi di Chimica Inorganica." Savona.
CHURCH, A. H., "Guida al Laboratorio." Venice, 1872.
CARLEVARIS, P., "Trattato di Chimica." Turin, 1870.
SELMI, F.. "Manuale di Chimica Inorganica." Turin.
TESSARI, N., "Compendio di Chimica Generale." Rovereto.

MODIFICATION OF MOHR'S BURETTE.

To the Editor of the Chemical News.

SIR,—I observe in your last issue a paper on "A Simple Modification of Mohr's Burette, to adapt it to all Test-Liquids," as suggested by Capt. Heriot and Mr. R. Biggs.

Allow me to refer those gentlemen to a communication made by me to the Bristol Naturalists' Association, in February, 1864, and reported in the CHEMICAL NEWS, vol. ix., p. 94, in which I described and exhibited an instrument precisely similar to theirs, and claimed for it the obvious advantages mentioned in the more recent paper.

I have had the instrument I then exhibited in frequent use since, but have recently discarded that and all other forms of burette in favour of the glass stop-cock modification, which is now made to perfection, is but slightly more expensive than the other sorts, and leaves nothing to be desired for ease and precision in manipulation.—I am, &c.,

EDWARD COLLENS.

Birmingham Vinegar Brewery,
October 23, 1872.

[In reference to this form of burette, another correspondent says that a similar one was used in Mr. Vernon Harcourt's and Mr. Esson's elaborate investigation into the laws of the rate of chemical change, at the Oxford University Laboratory. He calls our attention to one or two serious defects of the arrangement, which have more than once tempted him to abandon it for the glass stop-cock:—(1). Any change of temperature either expands the air above the fluid, and causes loss or excessive delivery, or else causes contraction, and rise of air into the beak, with consequent raising of the level of the liquid in the burette. In the latter case any attempt at adjustment is almost always accompanied with loss of fluid. (2). It is next to impossible to deliver single drops by the arrangement, unless the beak is so contracted as to give nothing else,—a state of things obviously inconvenient. (3). Leakage is always occurring at the cork, so that air is admitted above, under the strong pressure of the long column of fluid contained by the burette when full.—*Ed. C. N.*]

MISCELLANEOUS.

Salles du Progrès, Soirées et Matinées de Science Illustrée.—The Abbé Moigno has forwarded to us the comprehensive programme of a plan devised by him, the arrangements for which are now completed, to give popular instruction, varied by recreative musical and physico-chemical, optical, and other experiments and exhibitions, for the purpose, in the first place, of aiding the education of a large class of people in Paris who now spend too much of their time in frequenting cafés, chantants, and other places of amusement of a questionable character; and also of affording instruction to young men in science in its widest sense, inclusive of art and applied science. The Abbé Moigno considers that ignorance is at the bottom of the many evils and dangers of his country; and in order to instruct and elevate the mind, he has spared no pains or expense to render his Salles du Progrès attractive as well as useful, by judiciously combining the *utile dulci*. We sincerely wish him success, and trust that the institution may prove a real boon to that country of which we hope will be verified in more than one sense the *fluctuat nec mergitur* of the Parisian coat of arms, because—La France intelligente éclairée et libérale ne périt pas.

Quality of the Gas of London.—Dr. Letheby, the Chief Gas Examiner appointed by the Board of Trade, has recently reported to the Corporation of London, and the Metropolitan Board of Works, on the quality of the gas supplied by certain of the Gas Companies during the quarter which has just expired; from which it appears that the average illuminating power of the Chartered Gas has been as follows:—17·39 standard sperm candles at Beckton; 17·01 at Cannon Street; 17·45 at Friendly Place, Mile End; 17·96 at Arundel Street; and at Millbank 17·35. That of the Imperial Company has been, 17·46 candles at Oakley Square, Chelsea; 15·85 at Camden Street, Camden Road; and 16·59 at Graham Road, Dalston; while that of the South Metropolitan Gas Company at Hill Street, Peckham, has been 15·71 candles. The average illuminating power of the cannel gas supplied by the Chartered Company has been equal to 25·12 standard sperm candles at Arundel Street, Haymarket; and 27·10 candles at Millbank. With regard to purity, Dr. Letheby reports that the gas at all the testing places has been, except on two occasions, constantly free from sulphuretted hydrogen. The two occasions referred to were the 3rd of August and the 26th of September, when the gas of the South Metropolitan Company at Hill Street, Peck-

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ham, contained traces of this impurity, which he ascertained were due to unavoidable circumstances. The amounts of sulphur in other forms than this have averaged in the case of the Chartered Company's common gas, 11·19 grs. per 100 cubic feet at Beckton; 10·50 grs. at Cannon Street; 6·36 grs. at Friendly Place; 9·94 grs. at Arundel Street; and 23·37 grs. at Millbank. In that of the Imperial Company it has averaged 32·64 grs. at Oakley Square; 26·74 grs. at Camden Street; and 27·68 grs. at Graham Road. The amount of sulphur in the South Metropolitan gas has averaged as much as 33·4 grs. per 100 cubic feet. The average amount of this impurity in the cannel gas of the Chartered Company has been 15 grs. at Millbank, and 25·36 grs. at Arundel Street. It appears that, with one day's exception, the proportion of sulphur in the common gas of the Chartered Company at four of the testing places—viz., at Beckton; at Friendly Place, Mile End; at Cannon Street; and at Arundel Street—has not exceeded 20 grs. per 100 cubic feet during the whole quarter; and for the last two months it has not exceeded 15 grs. per 100 feet. This is very satisfactory, for it shows that with the care used at these works the proportion of sulphur can be kept under 20 grs. per 100 feet. The quantity of ammonia in the gas of all the Companies has been at all times below the prescribed amount of 2·5 grs. per 100 cubic feet. Dr. Letheby has drawn the attention of the Corporation and the Metropolitan Board of Works to certain irregularities in the returns of their Gas Examiners, and has pointed out the necessity of fulfilling the obligations of the several Acts of Parliament, which are in the interests of the public.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, October 14, 1872.

This number opens with a lengthy report by M. Tresca of the proceedings of the International Congress for Weights and Measures. The labours of the Congress are concluded.

New Process of Estimating Free Oxygen.—Schützenberger and Gérardin.—Hydrosulphite of soda, S_4O_3NaOHO, or, according to the new notation, SNaOHO, differs from bisulphite of soda only by 2 equivalents or 1 atom of oxygen; in the presence of free oxygen, that gas is at once absorbed by the hydrosulphite, and instantaneously converted into bisulphite, $S_4O_3NaOHO + O_2 = S_4O_4NaOHO$, or—

$$SNaOHO + O = SONaOHO.$$

The solution of the hydrosulphite of soda is readily obtained by causing zinc scraps to act upon a solution of bisulphite of soda (sp. gr. at 15°, 1·162) in a closed bottle for some twenty to twenty-five minutes; this solution is used to absorb oxygen gas, and has the advantage of not soiling the test-tubes like pyrogallate of potassa. The solution is also applied by the authors to test the presence and estimate the quantity of free oxygen dissolved in water, which is first tinged with Coupier's soluble aniline blue, a compound which is instantly decolorised by the hydrosulphite of soda, but is not acted upon by the bisulphite of that alkali; the solution of hydrosulphite is then added until decoloration takes place. As this reagent is prone to decomposition, it is titrated. The authors having found that the hydrosulphite decolorises a solution of ammoniacal sulphate of copper, while the sulphite and bisulphite of soda do not act upon it so long as ammonia is in excess, a strongly ammoniacal solution of that salt is so made that 10 c.c. of the fluid contain a quantity of copper corresponding, as regards the action of the hydrosulphite, to 1 c.c. of oxygen. The operation is conducted as follows:—A bottle of a capacity of from 60 to 100 grms. is partly filled with water, and a spiral of sheet-zinc and some lumps of granulated zinc are added; 10 c.c. of the solution of bisulphite of soda are then added, and the bottle next filled with water, and closed with a caoutchouc stopper. After having been shaken for a few moments, the vessel is allowed to stand for twenty minutes, and the reagent is ready. On the other hand, 20 c.c. of the copper solution (ammoniacal sulphate) are poured into a test-glass, and some oil is poured on the surface. A litre of the water to be tested is poured into a large-sized beaker-glass, and coloured by means of a few drops of Coupier's aniline blue, and some oil is also poured on its surface. With a graduated pipette, from 50 to 60 c.c. of the hydrosulphite solution are taken and poured gradually into the copper solution, taking care to stir it with a glass rod until decoloration takes place; next, with the same pipette, the hydrosulphite solution is poured gradually into the water also until decoloration takes place, care being taken in each case to hold the point. Supposing 17·5 c.c. of the hydrosulphite to have been used to decolorise the 20 c.c. of ammoniacal sulphate of copper, the quantity thereof corresponding to 2 c.c. of oxygen, and that, on the other hand, the litre of water has required 36·4 c.c. of the hydrosulphite solution, we put the following equation:—

$$17{\cdot}5 : 2 = 36{\cdot}4 : x = \frac{36{\cdot}4 \times 2}{17{\cdot}5} = 4{\cdot}16 \text{ c.c. of oxygen dissolved in the water.}$$

Anti-Ferment Substances.—A. Petit.—This paper contains the record of some experiments made with the view to ascertain the effect of certain substances on a fermenting liquid made up of 50 grms. of sugar to the litre, and 0·5 grm. of dry yeast to 10 c.c. of fluid. It appears that when silicate of soda and borax are added to such a solution, these salts exert no marked anti-fermentative action. 1 per cent of a solution of sulphate of iron does not affect the fermentation; but it is arrested by a 1 per cent solution of sulphate of copper. Phosphorus, oil of turpentine, mustard-powder, creosote, sulphuric and tartaric acids, all in quantities of 1 per cent, fail to affect fermentation; while 1-100th of arsenious acid renders the action more slow, 1-300th of oxalic acid renders it still slower. Acetic acid does not appear to be an anti-ferment, and a liquid containing 25 per cent of alcohol, 5 per cent of glycerine, and 1 per cent of succinic acid, enters readily into fermentation; on the other hand, corrosive sublimate and red oxide of mercury are strong anti-ferments, even in very small quantities. Sulphites do not impede fermentation, and are converted into sulphates.

Sitzungsberichte der Mathematisch-Physikalischen Classe der Königlich Bayerischen Akademie der Wissenschaften zu München, No. 2 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral subjects:—

Quantity of Ammonia Contained in Snow-Water.—Dr. Vogel.—This essay contains in the first place an excellent *resumé* of the labours of different *savants* on the presence of ammonia in the atmosphere and in arable soil, as well as in rain- and snow-water. The author refers to Dr. von Liebig's researches, made in 1826 and 1827, on the quantity of ammonia as nitrate in rain-water, and then records at length his own researches on the presence and quantity of ammonia contained in snow and in snow-water. The method employed by him in this instance is that of Schlösing, somewhat modified, as applied to the estimation of ammonia in arable soil; the following results were obtained, 1 litre of the snow-water being the unit:—Freshly-fallen snow, collected in a porcelain basin, at 0° gave 0·003 grm.; at −3° gave 0·002; at from −9° to −15° gave 0. Snow-water, from snow which had lain for twenty-fours on a piece of garden-ground manured during the previous autumn, contained 0·012 grm. Snow-water from snow which had been laying for twenty-four hours on a meadow contained 0·009. Snow (all of the same period of falling) which had been deposited for twenty-four hours on a zinc-covered roof contained 0·004. The author observes that the quantity of ammonia contained in snow depends upon a variety of conditions, and that since snow, owing to its porosity, absorbs ammonia, and the same obtains with the water formed from it, it is absolutely necessary to melt it in closed vessels. It appears that the quantity of ammonia contained in snow is also affected by the temperature at which it falls; at rather low temperatures (−15°, December, 1871) the author could not detect ammonia in such snow by Nessler's reagent for ammonia.

Photographic Effect (Licht Wirkung) of Variously Coloured Leaves.—Dr. Vogel.—Notwithstanding the high scientific value of this memoir, its contents are not suited for abstraction.

Observations on Minerals Occluded in Volcanic Rocks.—F. Sandberger.

Although not strictly belonging to chemistry, we quote the title of the following exhaustive memoir:—

Researches on Phyto-Electricity.—Dr. J. Ranke.

Preliminary Observations on Buchonite, a Kind of Rock Belonging to the Group of Nephelines.—F. Sandberger.—This memoir contains the exhaustive geognostico-mineralogical description of a new mineral discovered by the author in the Rhœn mountains, Bavaria, and called by him Buchonite (from Buchonia, apparently the ancient Latin name for the Rhœn district). The chemical composition of this mineral is, in 100 parts—Silica, 51·42; alumina, 15·39; protoxide of iron, 21·04; magnesia, 3·68; lime, 4·09; potassa, 1·07; soda, 2·37; water, 0·55; total, 99·61. A more complete analysis, including the undetermined small quantities of chlorine, phosphoric acid, titanic acid, and peroxide of iron, will be shortly published.

Spontaneous Decomposition of an Alloy of Lead.—Dr. Vogel.—It appears that among the collection of coins and medals belonging to the University of München there are preserved some copies of medals and coins made of a soft alloy—bismuth and lead—which was found to consist (when unaltered) of various proportions of the metals alluded to, viz.—(1). Lead, 66; bismuth, 34. (2). Lead, 86; bismuth, 14. (3). Lead, 88; bismuth, 12. It is apparent that these alloys were not

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all made at the same time; in some instances the medals cast in these alloys had not only become somewhat oxidised but even quite fallen to powder, which effervesced on being treated with acetic acid, and the solution was found to contain chiefly lead, but bismuth was also present. The author observes that it is rather curious that alloys kept in well-closed show-cases should have become thus altered and deteriorated; the cause is ascribed to the tendency of bismuth to crystallise, whereby a molecular change is first effected, and thus oxidation is rendered more easy.

Les Mondes, October 17, 1872.

Inauguration of the Salle du Progrès.—Mazas de Sarrion.—The opening meeting of this institution was held on the 15th inst.; among the distinguished *savants* present we notice the following:—Dr. Otto Struve, director of the Imperial Russian observatory on the Pulkova, and President of the International Congress for Weights and Measures held at Paris; M. Broch, formerly Minister of Marine for Norway, and also a member of the Congress just-mentioned; the eminent botanist, M. Gay; and Professor Chasles. The author speaks in high terms of the excellent plan of instruction adopted by the Rev. Abbé Moigno, and states that great satisfaction was felt by all present at the *tout ensemble* of the proceedings.

Disinfection and Collection of Fœcal Matters; Fahiman's System.—L. Créteur.—The description of a mechanical contrivance applied to a closet, by the arrangement of which the fœtid gases are destroyed, the fœcal matter collected, and a rich manure produced; but nothing is said relating to the chemical and disinfecting methods applied.

Aurora Borealis, Thunderstorms, and Waterspouts.—Rev. Laborde.—This lengthy paper contains the author's views on these phenomena, which are explained by viewing our globe as a large-sized Leyden jar.

Journal de Pharmacie et de Chimie, October, 1872.

This number contains the following original papers relating to chemistry:—

Researches on the Gases Contained in the Blood.—Mathieu and Urbain.—By means of a series of experiments, conducted with peculiarly-constructed apparatus, the authors have made a chemical analysis of the gases contained in the blood taken from living animals kept at normal conditions of diet and mode of living. It appears that the proportion of gas contained in the arterial blood of an animal is the same when that animal is in the same condition; it further appears that the quantity of gases contained in the smaller arteries is less, in consequence of the smaller quantity of blood globules present in these vessels. As regards the respiratory action, the authors are inclined to think that endosmose and diffusion of gases play a very important part in that action.

Animal Charcoal and Phosphate of Lime.—M. Collas.—The author first observes that there is, as far at least as decoloration is concerned, no necessity whatever to wash animal charcoal with dilute hydrochloric acid for the purpose of increasing thereby its decolorising property; he next observes that the hydrated phosphate of lime, the gelatinous precipitate caused by ammonia in an acid solution of bone-ash, has a powerful affinity for colouring matters, organic as well as inorganic, and that that substance by itself exerts a decolorising effect upon raw sugar. The conclusions drawn from these observations are that, far from being injurious, the phosphate of lime present in bone-black is really a useful ingredient, both on account of increasing the efficacy of the charcoal by rendering it more porous, and by acting as a decoloriser itself; bone-black should be washed with pure water before being used, and should be stored in cellars so as not to be exposed to direct sunlight.

Note on Testing Essential Oils for Adulteration with Alcohol.—M. Gault.—The essential oils, which are similar as regards their composition to the hydrocarbons ($C_{10}H_{16}$), are with difficulty dissolved in alcohol at 86 per cent applied in the proportion of 1 to 5. The essential oils containing oxygen, the composition of which is akin to aldehydes, and also such as contain sulphur, are more or less rapidly dissolved in alcohol of the same strength and applied in the same proportion; the mixture of these essential oils yields, even in the proportion of 1 to 10, a precipitate. If it is desired to make alcoholic solutions of essential oils—so-called essences—then the quantity of alcohol to be employed may be proportional to the degree of oxidation, the age, and the exposure to light and air of such oil.

Cultivation of the Cinchona Trees in Java.—M. van Gorkom.—In a letter to M. L. Soubeiran, the author states that the cultivation of these trees prospers in every respect; a manufactory has been established for the preparation on the spot of alkaloids, extracts, and other pharmaceutical preparations derived from the cinchona barks, and 6 tons of that bark were sold by public auction at Amsterdam in March last. The annual expenses of the cultivation, &c., are now balanced, and all the original outlay of capital is expected to be returned before the year 1876.

Neues Jahrbuch für Pharmacie und Verwandte Fächer, von Dr. F. Vorwerk, July, 1872.

In addition to original papers strictly belonging to pharmacy and pharmacognosy, this number contains the following original paper relating to chemistry:—

Metals Contained in Soot from Coals.—H. Reinsch.—The author states that, while testing some soot collected in a stove-pipe, he perceived the smell of arsenic; this gave rise to further experiments, the result of which showed that the soot contained iron, manganese, copper, arsenic, potassa, soda, and lime, in rather considerable quantities. The coal which yielded this soot is that found at Zwickau, Saxony.

August, 1872.

This number contains no original papers relating to chemistry.

La Revue Scientifique de la France et de l'Etranger, September 28, 1872.

In addition to several original papers strictly belonging to physiology, topography, and medicine, this number (retarded in transmission) contains a report of the proceedings of the Chemical Section of the late meeting of the French Association at Bordeaux, from which we abstract the following:—

Chloride of Silver.—M. Stas.—When recently precipitated, this substance is soluble in water, 1 litre dissolving 13 m.grms. at the ordinary temperature, and 25 m.grms. at boiling temperature. These solutions are precipitated by hydrochloric acid, as well as by nitrate of silver; 1 molecule of the chloride of silver requires, for complete precipitation, 3 molecules of either the acid or the salt. Bromide of silver is completely insoluble in cold water, and only slightly soluble (2 m.grms. to the litre) in boiling water. When chloride of silver is dissolved in acetate of mercury, it requires for precipitation a quantity of hydrochloric acid or of nitrate of silver in the proportion of 3 : 1.

Analysis of Phosphates.—M. Prat.—The native phosphate is first acted upon by bisulphate of ammonia at a high temperature, and is next treated with cold water; carbonate of ammonia is then added to the decanted solution, whereby lime and alumina are precipitated quite free from phosphoric acid, which is left in the solution and estimated as metaphosphoric acid.

Ozone.—Liès-Bodart.—Experiments made by the author prove that, while albumen is not acted upon by ozone—retaining even the property of coagulating by heat—blood albumen, which in consequence of its colouring matter cannot be used in calico-printing, becomes quite decolorised by the action of ozone, leaving white and perfectly coagulable albumen. It further appears that ozone is a very powerful disinfectant, since the author found that a room, in which sulphydrate of ammonium was purposely spilt, was readily disinfected by ozone.

Fulminating Compound.—M. Prat.—As a substitute for the fulminate of mercury in percussion caps, the author has used a mixture consisting of picrate of lead, chlorate of potassa, and a very small quantity of amorphous phosphorus.

Hydrofluoric Acid.—M. Prat.—By causing phosphoric anhydride to act upon anhydrous hydrofluoric acid, the author obtained water and a non-condensable gaseous hydrofluoric acid, thus rendering it probable that the substance hitherto viewed as hydrofluoric acid contains oxygen; the non-condensable hydrofluoric acid just alluded to yields, by saturation with oxide of silver, a fluoride of silver resembling the chloride and quite different from the ordinary fluoride of silver. From these researches it would follow that the bodies known as fluorides, fluor-spar for instance, is, instead of fluoride of calcium, an oxyfluoride, and that the atomic weight of fluorine is wrong.

Abnormal Density of Perchloride of Phosphorus.—M. Wurtz.—The abnormal density (sp. gr.) of this body is stated to be due to its dissociation into free chlorine and protochloride of phosphorus. The author has made a series of careful experiments with the view of avoiding the dissociation and estimating the density of the perchloride, by operating in an atmosphere of the protochloride; while the theoretical density of the perchoride of phosphorus is 7·219, the author has found the following cyphers:—7·069, 7·687, 7·317, 6·255, 7·061, 6·975, 8·203, 6·806, 7·143, 6·785, 6·656. The figures most differing from the theoretical density have been found under special conditions, and depend upon the *rapport* of the volumes of the vapours of perchloride and protochloride of phosphorus; the very high figures belong to experiments in which the bulk of perchloride was very small, while in the case of the low figures the volume of the perchloride was in excess of that of the protochloride.

October 19, 1872.

This number does not contain any original papers relating to chemistry, but we call attention to—

Bibliography.—"Leçons Elémentaires de Chimie Appliquée aux Arts Industriels," par M. J. Girardin, Correspondant de l'Institut; cinquième édition, entièrement refondue, avec figures dans le texte. Vol. II. Chimie minérale: métaux. Paris: Hachette. This is one of the best popular works on chemistry ever published, and contains very valuable short biographical notices of *savants*, chemists, manufacturers, and others, whose labours are quoted or referred to in this book.

PATENTS.

Communicated by Messrs. VAUGHAN and SON, Patent Agents, 54, Chancery Lane, London, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

2630. J. W. Pollard, Mincing Lane, J. Schofield, Mark Lane, and A. Butel, Bow, Middlesex, "Improvements in the treatment of spent oxides of iron for the purpose of extracting cyanides."—Petition recorded September 4, 1872.

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2648. A. C. Duncan and A. Duncan, Manchester, "Improvements in the production of Turkey red."—Petition recorded September 6, 1872.

2845. F. Walton, Staines, Middlesex, "Improvements in oxidising oil, and in machinery to be employed for that purpose."

2847. C. W. Harrison and A. H. Harrison, High Holborn, "Improvements in combining atmospheric air and certain gases for lighting and heating purposes."—Petitions recorded September 26, 1872.

2855. J. McKelvie, Edinburgh, N.B., "Improvements in the manufacture for illuminating gas."—Petition recorded September 27, 1872.

2861. C. W. Siemens, Westminster, "Improvements in the process for the production of iron and steel, and in furnaces or apparatus employed for that purpose."—Petition recorded September 28, 1872.

INVENTION PROTECTED FOR SIX MONTHS BY THE DEPOSIT OF A COMPLETE SPECIFICATION.

2950. T. Greener, Darlington, Durham, and W. Ellis, Gateshead, Durham, "Improvements in the manufacture of iron and in the production of "fetling" for improving the quality and yield of iron in the process of reduction."—Petition recorded October 7, 1872.

NOTICES TO PROCEED.

1604. R. Ironie, Leith, N.B., and J. Mackintosh, Buenos Ayres, Argentine, "Improvements in the manufacture of paper stock."—Petition recorded May, 27, 1872.

1616. J. H. Dennis, Liverpool, "Improvements in the treatment of copper precipitate, and in the utilisation of impurities contained therein."—Petition recorded May 28, 1872.

1649. M. Donbelt, Berners Street, Middlesex, "Improvements in the preparation of iron for purposes where great tensile strength is necessary."—A communication from L. Lwoff, St. Petersburg, Russia.—Petition recorded May 31, 1872.

1690. W. Riddell, Bishopsgate Street, London, "Improvements in the manufacture of paper pulp from vegetable fibres, and in apparatus therefor, which apparatus is also designed to be employed in making chloride of lime for bleaching pulp, and in other similar processes."—Petition recorded June 4, 1872.

1739. F. G. Morton, Bermondsey, Surrey, "An improvement in utilising tin-plate scraps or clippings, and in separating the tin and iron contained therein."—Petition recorded June 8, 1872.

1770. J. Birch, Newton Heath, Lancashire, "Improvements in the manufacture of iron and steel, and in apparatus to be used in such manufacture."—Petition recorded June 12, 1872.

1876. S. B. Smith, Birmingham, and J. W. Willans, Middlesbrough, "Improvements in the process of, and apparatus for, smelting iron ores and other ores, and re-heating iron and other metals, parts of which improvements may also be applied to other purposes."—Petition recorded June 21, 1872.

2318. J. Henderson, New York, U.S.A., "Improvements in converting cast-iron into steel and wrought-iron, and purifying cast-iron for foundry and other purposes."—Petition recorded August 3, 1872.

2358. T. Warren, Glasgow, N.B., "Improvements in, and connected with, furnaces employed in the manufacture of glass."—Petition recorded August 8, 1872.

2450. F. Lipscombe, Strand, Middlesex, "Improvements in the treatment of noxious vapours, and in apparatus or appliances in connection therewith."—Petition recorded August 16, 1872.

2518. W. Lochhead, Glasgow, N.B., "Improvements in treating asbestos or amianthus, and applying the same to various useful purposes."—Petition recorded August 24, 1872.

2692. F. A. Gatty, Accrington, Lancashire, "Improvements in producing certain colours on cotton fabrics and yarns."—Petition recorded September 11, 1872.

2766. W. E. Newton, Chancery Lane, Middlesex, "Improvements in the preparation of explosive compounds."—A communication from J. H. Norrbin and J. Ohlsson, Stockholm, Sweden.—Petition recorded September 18, 1872.

2786. P. P. F. Michea, Jubbulpore, East India, "New substances for dyeing, printing, and tanning, and the process employed for treating one of such substances."

2787. P. P. F. Michea, Jubbulpore, East India, "New substances for dyeing, printing, and tanning; also applicable for the manufacture of paper, and threads or yarns."—Petitions recorded September 20, 1872.

2827. C. J. A. Dick, Pittsburgh, Penn., U.S.A., and G. A. Dick, London, "Improvements in the manufacture of wires, applicable to telegraphic purposes."—Petition recorded September 25, 1872.

PATENTS SEALED.

1054. E. Sonstadt, Ramsey, Isle of Man, "Improvements in the manufacture of iodide of potassium and of bromide of potassium."—Dated April 10, 1872.

1243. S. W. Rich, Chenies Street, Middlesex, "Improvements in the manufacture of sulphates."—Dated April 25, 1872.

2035. B. Todd, Newcastle-upon-Tyne, "Improvements in the treatment of gases and fumes."—Dated July 5, 1872.

2389. H. A. Bonneville, Rue de la Chaussée d'Antin, Paris, "A new or improved process of manufacturing cast-steel."—A communication from H. A. Levallois, Rue de Chalrol, Paris.—Dated August 10, 1872.

2417. F. D. Blyth, Fenchurch Street, London, and A. G. Southby, New Inn, Strand, Middlesex, "Improvements in the process and apparatus for treating wood for the manufacture of pulp for paper."—Dated August 14, 1872.

2431. T. Routledge, Ford Works, near Sunderland, "Improvements in treating fibrous substances for textile purposes, and for the manufacture of paper stock."

2443. W. R. Lake, Southampton Buildings, London, "Improvements in puddling furnaces."—A communication from G. E. Harding, *New York*, U.S.A.—Dated August 15, 1872.

FOREIGN PATENTS.

AUSTRIA.

291. A. Brunner, "Improvements in the construction of blast-furnaces for iron.—Dated May 29, 1872.

295. F. Fischer, "Manufacturing paper for cigarettes."—Dated May 16, 1872.

304. J. Hiebl, "A mechanical and chemical process for obtaining white paper pulp of all sorts of wood."—Dated May 25, 1872.

325. K. Moser, "Reverberatory furnaces for roasting iron ores by means of the gas of blast-furnaces or other gases."—Dated May 30, 1872.

372. M. J. Elsinger and Son, "Waterproofing and improving tissues."—Dated June 28, 1872.

374. D. A. Fyfe, "Improvements in preparing paper materials, and in bleaching other substances."—Dated June 20, 1872.

379. J. Henderson, "Improvements in the manufacture of steel-iron, wrought- and cast-iron, from pig-iron."—Dated June 22, 1872.

404.—G. Rütgers, "Impregnating timber."

405. G. Rütgers, "An improved method of impregnating timber with a solution of mercurial sublimate."—Dated June 1, 1872.

409. W. C. Tenchert, "A galvanic battery with salts of great solubility and an increased current."—Dated June 8, 1872.

BELGIUM.

31094. C. Vanden Hoff, "Preserving game in cases."—Dated August 26, 1872.

31111. L. G. G. Daudenart and E. Verbert, "Treating yolk and other suds by means of barytes, &c."

31112. L. G. G. Daudenart and E. Verbert, "Manufacturing baryta salts."—Dated August 29, 1872.

31116. C. Morfit, "Improvements in the manufacture of pure phosphates of lime."

31118. J. Buzino, "A tooth-powder."—Dated August 30, 1872.

31120. F. G. Prange and W. Whitthread, "Improvements in utilising sewage."

31123. C. Morfit, "Improvements in the chemical treatment of phosphates, minerals, &c."—Dated August 31, 1872.

31127 C. Morfit, "An artificial product for superseding guano."

31131. M. F. R. Faure and J. L. Kessler, "Improvements in concentrating and evaporating sulphuric acid."—Dated September 2, 1872.

31132. A. Grandvallet and F. Kienast, "An apparatus for warming railway-carriages, and chemical coal employed therefor."—Dated September 3, 1872.

31142. C. M. T. du Motay, "Improvements in the construction and use of blast-furnaces."

31144. D. Putzeys and Bouvrie, "Improvements in the manufacture of glass."—Dated September 5, 1872.

31 146. E. Marton and L. Havet, "Food called mealy cream."

31151. A. J. Martelette, "A composition for removing incrustation in steam boilers."—Dated September 6, 1872.

31589. C. Prouvost, "A mixed dye for obtaining several tints by a single immersion."—Dated September 7, 1872.

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THE CHEMICAL NEWS.

VOL. XXVI. No. 675.

NOTE ON THE ANALYSIS OF SOAPS.

By F. JEAN.

ALTHOUGH there are still soap-boilers who make *bona fide* soaps, containing no less than 54 per cent of fatty acids, and not more than from 35 to 40 per cent of water, the desire to produce low-priced soaps has led to the introduction of various substances which can only be considered as fraudulent adulterations. Resin (colophonium) is one of the most common of these substances. It is known that resin, when combined with potassa or soda, forms a resinate which, when mixed with water, yields an abundant lather, and this substance is now generally used in the manufacture of soaps. In some countries, however, it is only used in soft soaps. It certainly renders soaps more suitable for use with hard, or even sea, water, but its use is decidedly injurious for some of the applications of soap; for instance, when resin soap is used in the fulling of woollen cloth, it produces peculiar greasy spots, and woollen materials washed with soaps containing resin are difficultly mordanted, and not uniformly dyed. Unfortunately we possess no process by which resin can be accurately separated from the fatty acids. The oldest process of separation—that of Sutherland—consists in boiling the mixture of fatty acids and resin with concentrated nitric acid until the evolution of nitrous acid gas ceases: the resin, thus converted into terebic acid, which is soluble in water, is easily separated from the fatty acids, and these, according to Sutherland, are scarcely acted upon by the nitric acid; but in reality the reaction is not so simple, for, in addition to terebic acid, there is formed azomaric acid, which, being insoluble, remains mixed with the fatty acids, and the latter are, moreover, acted upon to some extent by the nitric acid, the result being that products soluble in water are formed;* the oleic acid is not simply converted into its isomeric elaidic acid, and it is therefore evident that this process does not give reliable results.

Gottlieb's process, as described by Bolley, is altogether useless; the sulphate of magnesia precipitates the bulk of the resinate along with the magnesia soap, and hardly a trace of resin is separated. Rampal's process, described in his memoir on Savonimetry, published as a prize essay by the Société Industrielle de Mulhouse, does not quite answer the purpose. According to this author, the separation of mixed fatty acids and resin is effected by dissolving the same in from 5 to 10 parts of boiling alcohol, and the addition to that liquid of an equal bulk of boiling water; the fatty acids float on the top of this liquid, while the resin is precipitated in the shape of a finely divided powder: it is true that the resin is separated, but in the first place it requires a far larger quantity of water, and some of the fatty acids are precipitated with the resin. If boiling water is added to a boiling alcoholic solution of pure fatty acids, the liquid becomes milky, and remains so for several days: it is thus evident that Rampal's process is not satisfactory.

Cailletet's process admits of qualitatively detecting resin in soap, in the following manner:—10 c.c. of the aqueous solution of the soap to be examined are poured into a narrow test-tube, and dilute sulphuric acid in slight excess is added; the fatty acids thus separated are then dissolved by the addition of some 2 or 3 c.c. of oil of turpentine, while the resin remains in the liquid as a flocculent substance.

Finding that the processes described in works on analytical chemistry for the separation of resin from fatty acids are not reliable, I considered that a more elaborate examination of the properties of the resinates might lead to the discovery of a more practical process for the separation and estimation of the resin in soap. I first tried to saponify the resin, by boiling it with caustic soda lye; but since the resin floats on the top of the boiling liquid saponification in this way becomes a slow affair: in practice on the large scale the resin becomes mixed with semi-saponified fatty matter, and then the resin itself is readily acted upon. By operating, however, in a small Papinian boiler, at a pressure of 3 atmospheres (75 lbs. to the square inch), the saponification proceeds rapidly. With 100 grms. of resin and 200 c.c. of caustic soda lye, at 15° Baumé = 1·116 sp. gr. = about 8 per cent of dry caustic soda, I obtained complete saponification in half an hour. The saponified material consists of an insoluble portion, A, and of a soluble portion, B; 100 grms. of resin gave 135 grms. of the resinate A and 75 c.c. of the resinate B.

Investigation of the Resinate A.—The resinate A, separated from the soluble resinate B by washing with a caustic soda solution at 5° Baumé, resembles dark-coloured soft soap, of a somewhat gelatinous consistency; its colour is bright brown; the substance is not very soluble in cold water, but it is soluble in boiling water, alcohol, and oil of turpentine. On being analysed I found it contained 54 per cent of yellowish-brown-coloured resin, 3·1 per cent of soda, and 49·2 per cent of water. The aqueous solution of the resinate A, previously freed from excess of alkali, exhibits the following reactions:—the chlorides of sodium and barium, bicarbonate of soda, acetate of lead, sulphate of magnesia, sulphate of soda, chloride of potassium, and ferrocyanide of potassium, form precipitates; caustic soda solution also precipitates the resinate from its aqueous solution; sulphate of potassa, ferricyanide of potassium, neutral borate, and phosphate of soda, fail to give precipitates. Resinate of baryta is soluble in ether. When resinate of soda is decomposed by an acid, there is formed a milky liquid in which flocculent resin floats about; on being boiled these flocks unite, yielding the resin A. This resin, insoluble in water, soluble in alcohol, ether, and oil of turpentine, exhibits an acid reaction. The alcoholic solution forms precipitates with alcoholic solutions of the acetates of lead and copper; it becomes turbid by the addition of water, but the turbidity disappears on the addition of ammonia.

Investigation of the Resinate B.—This substance is soluble in water and alcohol, but insoluble in oil of turpentine and ether; it contains 16·5 per cent of soda. The chlorides of sodium and barium, form precipitates in the aqueous solution of the resinate B; the sulphates of soda and potassa, the ferro- and ferricyanides of potassium, chloride of potassium, and caustic soda, do not produce precipitates, while the precipitation by means of chloride of barium is incomplete, and the precipitate itself insoluble in ether.

The resin B, set free by the action of an acid, is a brittle brown-coloured substance, soluble in alcohol, insoluble in oil of turpentine, and in ether; the alcoholic solution exhibits an acid reaction. The aqueous solution, from which I separated by means of a weak acid the resin B, having been neutralised with soda, yields, after evaporation to dryness, a residue which on being treated with alcohol gave a resinous matter resembling shellac, and exhibiting a slight acid reaction. This body, C, soluble in water, reduces Fehling's liquor, and precipitates nitrate of silver, and sulphate of copper. By the saponification of resin there are consequently three distinct substances generated, viz., a resinate insoluble in alkalies, a soluble resinate, and a substance which is not separated from its acid solutions.

* Boil pure fatty acids for half an hour with concentrated nitric acid, dilute with distilled water, filter, and next saturate the solution with soda, and on evaporating to dryness there will be left an odorous, yellow-coloured mass, which becomes black on being calcined, thus indicating the presence of organic matter soluble in water. Suberic, pimelic, adipic, propionic, butyric, œnanthylic, succinic acids, and other substances are formed.

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The investigation of these resinates has led me to adopt the following process for the separation and estimation of resin in soaps :—Dissolve 10 grms. of the soap in 100 c.c. of distilled water; pour into this solution a slight excess of a concentrated solution of pure caustic soda, whereby the soap of the fatty acids and the resinate A are precipitated and separated from the resinate B, soluble in alkaline solution ; filter, wash with a solution of caustic soda, and add the washings to the filtrate. The alkaline liquor, which contains the resinate B, is acidified with dilute sulphuric acid, boiled, next poured upon a filter previously weighed and dried at 100° upon which the resin B is left. The acid solution (filtrate from B) is carefully saturated with soda* and next evaporated to dryness; the residue is treated with alcohol to separate the sulphate of soda, and the alcoholic fluid evaporated on a previously weighed porcelain basin, the residue of this evaporation being resinoid matter mixed with glycerine. The presence of this latter body may be ascertained by heating the residue in a test-tube with some peroxide of manganese, a few drops of sulphuric acid, and alcohol of 0·824 sp. gr.; formic ether is then formed, and recognised by its smell, which resembles that of peach-blossom.

I have found that at boiling-heat glycerine decomposes iodic acid, so that iodine is set free. This may be detected by its colouring paper previously impregnated with a solution of starch. This reaction is characteristic for glycerine. After having been washed with a solution of soda, the resinate of soda A and the fatty acids are dissolved in boiling water, and next precipitated by a slight excess of chloride of barium ; the insoluble resinate and soap of baryta are separated by filtration, washed and dried at 100°, and next treated with ether, which dissolves the resinate of baryta, leaving the barytic soap in an insoluble state. The ethereal solution is evaporated to dryness and the residue, dissolved in boiling distilled water, decomposed by means of a few drops of sulphuric acid, whereby the resin is set free. This resin is collected on the same filter which already contains the resin B, and having been washed with tepid water is dried at 100° and weighed. The baryta soap suspended in the acidulated water is decomposed by ebullition, and the fatty acids set free are carefully collected and weighed. By this process we ascertain the weight of the resin, fatty acids, and resinoid matter mixed with glycerine and contained in the soap.

It frequently happens that soaps contain large quantities of foreign substances, such as starch (almost always present in soft soap), French chalk, ochre, clay, and the alkaline earthy sulphates, &c., substances fraudulently added for the purpose of rendering soap heavier. These adulterations are readily eliminated by dissolving the soap in alcohol of 0·824 sp. gr., whereby a portion of the chloride of sodium, and the sulphate and carbonate of soda are separated. At the present time the mixing of a concentrated solution of silicate of soda with the still pasty and warm soap mass is very general. I have found a soap of excellent appearance to contain 17 per cent of silicate of soda. As silicate of soda is insoluble in alcohol, it is readily separated by dissolving the silicate in water. The gelatinous silica may be separated either by the addition of a dilute acid, or by boiling with an aqueous solution of chloride of ammonium.

The estimation of the excess of alkali is generally done by treating soap with alcohol, this separates carbonate of soda which is insoluble therein ; but since caustic alkali is soluble in alcohol, I estimate the excess thereof in the following manner :—An alcoholic solution is made of the soap under examination ; after filtering off the matters insoluble in alcohol, the alcoholic filtrate and washings are placed on a water-bath and a current of carbonic acid passed through the alcoholic solution ; all the non-combined alkali is thus carbonated, and becomes insoluble in the alcohol. It is then only required to estimate the quantity of carbonated alkali by volumetry, and to calculate from this result to caustic alkali. By means of this process I have been enabled to correctly determine the quantity of alkali saturated by 100 parts of anhydrous fatty acids.* By saponifying with different quantities of soda pure fatty acids, I have obtained 12·3, 12·5, 12·9, 12·4 of alkali, or on an average 12·9 of soda for 100 anhydrous fatty acids. Soap being really salts, it becomes, when the quantity of combined alkali is known, an easy matter to calculate the thereto corresponding quantity of fatty acids, thus reducing the analysis to a simple alkalimetric operation. From 2 to 3 grms. of the soap to be tested are dissolved in alcohol of 0·824 sp. gr., and, without filtration, this solution is placed on a water-bath and treated with a current of carbonic acid ; the liquid is next filtered and the filter washed with alcohol ; the filtrate is diluted with water, and then boiled for the purpose of driving off the alcohol ; from 5 to 10 c.c. of titrated sulphuric are added, and the liquid kept boiling until the fatty acids appear to be quite clear. After cooling and solidification of the fatty acids, the liquid is filtered and the filter washed with tepid distilled water ; and next, the excess of sulphuric acid in the liquid is determined by means of a titrated solution of soda. By means of calculation the quantity of sulphuric acid saturated by the alkali of the soap is found. The quantity of combined alkali contained in 100 parts of soap being known, it is only necessary to multiply the quantity of alkali found by 100, and to divide by 12·6 to obtain the weight of the anhydrous fatty acids combined with the quantity of alkali found. The weight of the fatty acids and alkali together being subtracted from 100, gives the quantity of water and impurities contained in the soap which was tested. This process of analysis cannot be applied when soaps contain resin.

In the case of soap made by empâtage, it is necessary before treatment with alcohol to boil it first in a solution of common salt, for the purpose of eliminating the organic soda-salts (butyrates, hircates, &c.) ; for as these salts are not decomposed by carbonic acid, they would behave like alkali combined with fatty acids.

Some soaps often contain a large excess of water. Soaps made with cocoa-nut oil contain frequently a fabulously large quantity of that liquid (100 of the cocoa-nut oil yielding 500 soap). It is therefore of importance to estimate the quantity of water. The usual process, drying of from 2 to 5 grms. of soap previously converted into shavings at 100°, does not give satisfactory results; for while drying, soap swells, and thus retains some water, while a high temperature may cause it to become carbonised. I estimate the water in soap by the following process :—From 1 to 2 grms. of soap-shavings are placed in a previously weighed porcelain capsule and dissolved in the smallest possible quantity of strong alcohol; next I add a weighed quantity of fine dry sand for the purpose of absorbing all the liquid, and then I dry at 110° ;† the drying proceeds rapidly, and the sandy powder may be used for the purpose of estimating the non-combined fatty matter by treatment with sulphide of carbon.

* If this operation should give rise to the formation of a precipitate, *it should be* added to that filter which already contains the resin B.

* The theoretical figure as deducted from the formula of the fatty acids would be for tallow, 10·8 ; for oil, 10·77. According to Rampa, the quantity of alkali contained in soaps should be equal to the tenth part of the weight of the fatty acids; according to Roux and Arnaves, it should be 11·5 per cent; and according to Chevreul, taking the average of the three fatty acids, there should be 12·14 parts of alkali (soda) upon 100 parts of anhydrous fatty acids.

† Before weighing, the capsule containing the dried soap should be placed for the purpose of cooling in an exsiccator (over strong sulphuric acid), as soap is hygroscopic, and would again absorb water from the air.

A NEW AND READY METHOD OF FORMING PLATINUM-BLACK.

By J. LAWRENCE SMITH.

ALL those who have employed the usual methods of forming platinum-black know that it is attended with

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some little trouble: having considerable experience in the decomposing of the platin-chlorides of the alkalies by hydrogen, and by ordinary street gas, the resultant products have been frequently examined, and I find that an excellent platinum-black can be thus prepared; whether equal to the best formed by other processes, I am not prepared to say:—I prefer taking platin-chloride of potassium, and were it not that rubidium and cæsium are too expensive, these would be even better, for their atomic weights are higher than that of the potassium, and consequently the particles of platinum are more widely separated. After the platin-chloride is completely reduced, the mass is treated with water to wash out the chlorides of the alkalies thoroughly; the residue is dried at a temperature not exceeding 220° F., when it is ready for use. The operation can be readily conducted in a capsule of porcelain or platinum; the platin-chloride is introduced, and covered with a circular piece of mica a little smaller than the wide diameter of the capsule, with a hole in the centre, through which the tube conducting the gas is introduced. The capsule is then heated by any convenient arrangement by which a temperature not exceeding 400° or 500° F. is obtained, at which temperature it can be maintained with a little management; a small Bunsen burner with a rosette can be used. If the temperature be too high the platinum-black will not be as good as that made at a lower temperature. Washing the platinum-black, after the chloride is taken out, with a solution of caustic potash or soda, and subsequently washing with distilled water, may improve the product. — *American Chemist.*

ELECTRO-MAGNETIC DEPOSITION OF NICKEL.

By J. M. MERRICK, S.B.

In the following experiments solutions of salts of nickel were subjected to the action of the galvanic current by plunging into the solution a platinum plate, about 3 inches in length by ½ inch in width, connected with one pole of a battery of two medium Grove's cells, while a nickel plate was used in the solution as an anode. In the circuit was placed a sensitive rheostat, by means of which the current could be kept at a definite intensity, and a voltameter, by which the mixed volume of gases from the decomposed water could be measured. From this volume the volume of hydrogen could be ascertained, and from this volume reduced to dryness, zero, and the normal pressure, the amount of metal which should be deposited in a given time could be found.

The weight of metal actually obtained was found by the increase in weight of the platinum slip used as a cathode, which was provided with a platinum wire soldered to it, by which it could conveniently be attached to the balance.

The difference between these weights, taken into consideration with the character of the deposit, shows the value of the solution used for plating purposes. The time of the action of the battery was generally one hour. The observations were made with a good thermometer and a carefully corrected aneroid barometer.

Acetate of Nickel,—Sp. gr. of solution, 1·0232. The deposit was in large measure pulverulent, velvety, and black, consisting of nickel oxide. This was rubbed off before weighing the cathode, and the result of the experiment showed a deposit of metal equal to *one-tenth*, 10 per cent of the amount represented by the liberated hydrogen. Smee remarks ("Manual of Electro-Metallurgy," p. 194) that the acetate is a bad solution for obtaining reguline metal.

Cyanide of Nickel and Potassium.—With this solution there was an abundant evolution of gas from the cathode. The deposit was a dull blackish grey, and streaked.

The amount of metal was 14 per cent of the theoretical quantity.

Chloride of Nickel.—This salt was prepared with care from a nearly anhydrous chloride, and was of a sp. gr. 1·0503.

The deposit was in large measure black, velvety, and easily rubbing off, but leaving a surface of metal underneath.

It gave 83·6 per cent of the theoretical amount of nickel.

The velvety oxide was tested for manganese, but none was found. The character of the metallic as a plated surface was poor. It will be remarked that Smee (*loc. cit.*) extols this solution as excellent for plating purposes.

Sulphate of Nickel.—The solution used was made from a very pure and carefully prepared salt, and had a sp. gr. of 1·0223.

The deposit was blackish, and streaked with a greenish deposit above it. This greenish deposit [subsulphate] having been rubbed off, assuming all the rest to be metal, this solution gave a deposit of 52 per cent of the theoretical amount.

Ammonio-Sulphate of Nickel.—This salt was made by adding an excess of ammonia, and then alcohol, to a strong solution of the sulphate of nickel. The precipitated salt was re-dissolved in water.

The deposit was a greyish-brown "mat" (to use a technical word), with some streaks, but no lustre or polish. It was wholly metallic, however, and amounted to 96 per cent of the required amount.

Ammonio-Chloride of Nickel.—A solution of this salt, prepared like the corresponding ammonio-sulphate, gave a bright metallic streak upon the upper side of the cathode, and the rest of the deposit a dull mat, amounting to 96 per cent of the quantity required by theory.

Ammonio-Nitrate of Nickel.—A solution of this salt, of sp. gr. 1·016, gave a deposit largely greenish (subnitrate?), with a various coloured metallic deposit underneath, amounting to 97·4 per cent of the theoretical quantity.

Sulphate of Nickel.—Another (commercial) sample. In this experiment there was an enormous evolution of gas from the cathode, and a considerable evolution from the anode. The other layer of the deposit was greenish. This, on being rubbed off, left a speckled and blotched metallic surface.

The metal gave 107 per cent of the theoretical amount, showing that some oxide must have been weighed as metal.

Nitrate of Nickel.—This was a solution made from a very pure re-crystallised salt. It gave a thick greenish deposit (subnitrate?), with a metallic layer underneath, apparently equalling 130 per cent of the theory, which simply shows how difficult it is by mechanical means to clean the platinum plate from oxide, or other non-reguline matters, in these bad deposits.

Double Sulphate of Nickel and Ammonia.—This gave a good metallic deposit, equal to 93·5 of the theoretical amount.

Double Chloride of Nickel and Ammonia.—This was a solution of the double salt, containing possibly a trifling amount of alcohol. It gave a pulverulent deposit, with a metallic deposit underneath, dirty looking and striped, equal to 47 per cent of the theoretical amount.

Double Sulphate of Nickel and Potash.—This was a solution of a salt prepared with the utmost care, from presumably pure materials, and re-crystallised.

There was a considerable evolution of gas from the cathode, and the deposit was blackish-green in nodules, with a dull metallic layer underneath. This metallic layer amounted only to 37 per cent of the theoretical amount of nickel.

My experiments seem to show that the number of salts of nickel that will furnish a bright metallic deposit of anything near the theoretical amount is extremely limited.

I find it very difficult to reconcile my results with the sweeping statement of Becquerel ("Elements d'Electro-Chemie," 1864, p. 325), viz., that a brilliant white metallic deposit, of a slightly yellowish tint (un dépot metallique blanc brillant avec une très-légère teinte jaunâtre), can be obtained from a solution of sulphate of nickel in which the excess of acid has been saturated with potassa or soda.

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SUGGESTIONS FOR THE EFFECTIVE WORKING OF THE ADULTERATION OF FOOD, DRUGS, &c., ACT, 1872.

The following is the Report read at a large Meeting of the Association of Medical Officers of Health, held October 28th, 1872:—

1st.—That, in their opinion, the Adulteration of Food Act, 1872, notwithstanding its imperfections, is capable, with proper management, of being made an important and valuable public measure; but to this end it will be necessary to carry out its several provisions in the fullest and fairest manner, having proper regard for the interests of commerce and trade, as well as for those of the public.

2nd.—That if the Act be put in force in this Metropolis, it will be most desirable and expedient that the several analysts appointed by the Vestries and District Boards should work conjointly, and in accordance with some prearranged system. This will not only be the means of securing uniformity of results and agreement of opinions, but it will also serve to check the conflict of scientific testimony, and will afford the best guarantee for the full, fair, and effective working of the Act.

3rd.—That to this end, as well as for the sake of economy, it is advisable that all the work of analysis throughout the Metropolis should be performed in as few laboratories as possible, say two; and that skilled assistants should be constantly engaged therein to conduct the analyses, under the superintendence and in the presence of the appointed analysts.

4th.—That as this will entail a large expense, it will be necessary for each of the Food Analysts appointed by the Vestries and District Boards of the Metropolis to contribute, *pro rata*, according to the amount of work done, towards the maintenance of the said laboratories, &c.

5th.—That, guided by the practical experience of two of the members of the Committee, namely, Dr. Letheby, the Professor of Chemistry in the College of the London Hospital, and Dr. Stevenson, the Lecturer on Chemistry at Guy's Hospital, the Committee are of opinion that the work of Analysis, &c., under the Act, cannot be fully and effectually performed at a less charge to the Vestries and District Boards of the Metropolis than from one to two hundred pounds per annum to each of the appointed analysts; for, in considering the question of salary, the Committee have had regard not merely to the great expenses of the laboratory, but also to the time and attention required from each of the analysts, in the supervision and conduct of his laboratory work, and in the proceedings which must arise out of it.

6th.—The Committee are strongly of opinion that if a too strict economy is exercised by the local authorities who are appointed to carry out the provisions of the Act, whether in this metropolis or in the country, the objects of the Act will not be attained, and the interests of the public will not be served; for the Act will either become a dead letter, as in the case of the Act of 1860, or it will be made the medium of persecution, and perhaps also of the most offensive quackery. Already there is evidence of this, and we submit, for the earnest consideration of local authorities, that those who are appointed analysts under the Act should be strictly debarred from giving any certificate or testimonial as to the purity or impurity of any article of food, or drink, or drug, other than for the purposes of the Act, and every certificate should be so worded as to prevent its use for advertising trade purposes.

7th.—That as the success of this Act will largely depend on the manner in which the duties cast on the Inspector are carried out, it is considered advisable that he should be under the direct control of the local authority, or of the analyst, in purchasing or procuring samples of food, drink, or drug, for analytical examination.

Hy. Letheby, M.B., *President.*

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, October 1st, 1872.

Rev. William Gaskell, M.A., Vice-President, in the Chair.

Among the donations announced were a beautiful photographic copy of a fine portrait of the late Mr. John Dawson, of Sedburgh, by Mr. Westall, A.R.A., and a fine photographic portrait of the Rev. Canon Sedgwick, M.A., F.R.S., Honorary Member of the Society, both presented by Canon Sedgwick.

On the motion of Mr. Baxendale, seconded by Mr. Kipping, the thanks of the Society were unanimously voted to the Rev. Canon for his interesting and valuable donations.

"*On the Composition of Ammonium Amalgam*," by R. Routledge, B.Sc.

The substance now known as ammonium amalgam appears to have been first obtained by Seebeck* in the beginning of the year 1808, immediately after Davy had announced his brilliant discovery of the isolation of potassium and sodium by means of the Voltaic battery. Seebeck prepared the amalgam by placing mercury which formed the negative pole of a battery in contact with moistened carbonate of ammonia. About the same time Berzelius and Pontin† obtained the like result with solution of ammonia. This discovery they communicated to Davy early in June, 1808, declaring their conviction that ammonia, like potash and soda, must be an oxide, and that the new substance was a combination of its metallic constituent with mercury. Davy‡ immediately commenced a series of elaborate experiments on the production and properties of the amalgam; and in an account of these experiments laid before the Royal Society in the same month, he first uses the name ammonium to indicate the supposed metallic basis of ammonia. So convinced was Davy that the substance united with mercury in the amalgam was of a metallic nature, and that by combining with oxygen it constituted ammonia, that he was inclined to view nitrogen and hydrogen, if not as oxides of metals, at least as metallic gases.

Davy discovered that the ammonium amalgam was readily produced when an amalgam of potassium was made to act on moistened sal-ammoniac. He found that the electrically prepared amalgam when introduced into a tube rapidly evolved gas, which he describes as consisting of "about two-thirds to three-fourths of ammonia, and the remainder hydrogen." In another experiment, amalgam obtained by potassium was moistened with strong liquid ammonia, and when heated in a tube generated gas which was proved to consist of two-thirds ammonia and one-third hydrogen.

In the following year Gay-Lussac and Thénard‖ investigated the ammonium amalgam, and were led to regard it as a triple compound of mercury, ammonia, and hydrogen. They found on putting some of the amalgam prepared by potassium into a tube which was filled up with mercury and then inverted in a vessel of that liquid, that the amalgam gave off, in decomposing, ammonia and hydrogen gases in the proportion of 2½ volumes to 1. But the electrically prepared substance gave off the gases in quite another proportion, the ratio in four different experiments being nearly as 28 volumes of ammonia to 23 of hydrogen. These results were obtained by first drying the amalgam with bibulous paper, then introducing it into a tube containing a little mercury, closing the tube with the finger, agitating it for some minutes with the enclosed

* *Annales de Chemie*, lxvi., 191.
† Gilb., vi., 260, and *Bibliotheque Britannique*, No. 323, 324, p. 122.
‡ *Phil. Trans.*, 1808, p. 355.
‖ "Recherches Physico-Chimiques," i., 52.

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air, opening the tube after inversion in mercury, measuring the ammonia by absorbing with water, and determining eudiometrically the hydrogen mixed with the residual air. The amalgam was afterwards described by Thénard, in his "Traité de Chimie,"* under the name of "ammoniacal hydride of mercury."

It is interesting to observe that in 1816 Ampère,† in the passage where the now universally received views on the constitution of ammoniacal compounds are first propounded, refers to the amalgam. Speaking of the difficulty of assimilating the constitution of ammoniacal to metallic salts, he remarks—"This difficulty would disappear if we admit that, just as cyanogen, although a compound body, exhibits all the properties of the simple bodies which are capable of acidifying hydrogen, so the combination of one volume of nitrogen and four volumes of hydrogen which is united to mercury in the amalgam discovered by M. Seebeck, and to chlorine in the hydrochlorate of ammonia, behaves in all the compounds which it forms like the simple metallic substances." This theory was more fully developed by Berzelius, and was soon generally received, except as regards the amalgam, concerning which various conflicting opinions were entertained. Daniell,‡ for example, speaks of it as a mere mixture of mercury and gases resulting from the cohesion of the mercury and the adhesion to it of the gases, and he cites the absorption of oxygen by melted silver as a similar case.

Grove,‖ in 1841, made a few experiments on the amalgam, and advanced the idea that it is a chemical compound of mercury and nitrogen, merely swelled up with hydrogen.

In 1864, Dr. Wetherill§ performed several ingenious experiments on the amalgam, without, however, attempting any quantitative estimate of its composition. He concludes that it is not an alloy of mercury and ammonium, and that the swelling up of the mass is due to the retention of gas bubbles by virtue of some unexplained action which he somewhat vaguely refers to catalysis.

In the *Annalen der Chemie du Pharmacie* for 1868¶ is a paper by Landolt, in which, after pointing out the discordance of the quantitative results obtained by Davy, and by Gay-Lussac and Thénard, he describes a method by which he attempted a new determination of the relative quantities of ammonia and hydrogen. He prepared the substance from a solution of sal-ammoniac, separated from the mercury, which formed the negative pole, by a porous cell. The amalgam, when removed from the circuit, was washed in a stream of water to get rid of the adhering solution of sal-ammoniac, which always contains free ammonia. It was then immediately plunged into dilute hydrochloric acid of known strength, and the hydrogen evolved was received into a graduated cylinder placed over it, while the ammonia was estimated by determining the amount of unneutralised acid in the liquid. Two experiments gave results corresponding respectively to 2·15 and 2·4 volumes of ammonia to 1 of hydrogen. These figures of Landolt's cannot be considered satisfactory, neither nearly agreeing with each other, nor approximating to the ratio 2 : 1 sufficiently closely to justify his conclusion that they "completely confirm the results formerly obtained by Davy." Indeed Landolt points out a serious defect in his process, namely, that however rapidly the amalgam may, after washing, be transferred into the acid, the adhering water will nevertheless take up some more ammonia from the continuously decomposing substance while the hydrogen escapes.

It must be observed that Davy himself appears to have found a difficulty in obtaining consistent results, for he does not seem to have ever entirely satisfied himself as to the proportions of the two gases. These are the words in which he sums up his observations:—"As it does not seem possible to obtain an amalgam in an uniform state, as to adhering moisture, it is not easy to say what would be the exact ratio between the hydrogen and ammonia produced, if no more water was present, than would be decomposed in oxidating the basis. But in the most refined experiments which I have been enabled to make, this ratio is that of one to two; and in no instance in which proper precautions are taken is it less, but under common circumstances often more. *If* this result is taken as accurate . . . .", &c.*

This statement of Davy's being apparently the only authority for the assertion that the decomposing amalgam gives off the gases in atomic proportions, and yet being in conflict with Gay-Lussac and Thénard's results, it appeared to me desirable to attempt to obtain more exact determinations.

I used amalgam prepared by electricity in the manner described by Landolt.

A simple mode of eliminating the disturbing effect produced by the attraction of ammonia for moisture suggested itself. A U-shaped glass tube was provided, open at both ends, about 1·4 centimetres in diameter, and having its shorter limb 40 centimetres long. At the bottom of the longer limb, just above the bend, there was an outlet tube to which was attached a piece of caoutchouc tubing closed by a pinch-cock. Mercury was poured into the tube until it filled about two-thirds of the shorter limb, into which was then introduced the amalgam after the latter had been wiped with filtering-paper. Then into the end of the limb containing the amalgam, a caoutchouc stopper, perforated with a small opening, was immediately thrust so far that its upper surface came a little below the rim of the tube. The decomposition of the amalgam was then allowed to proceed for a few minutes, during which period any moisture adhering to the amalgam or present in the tube would become completey saturated with ammonia, and then the two gases would begin to escape through the perforation in the stopper in the proportions in which they are really evolved. Mercury was now poured into the open end of the longer limb until the amalgam just made its appearance at the top of the hole in the stopper, which was then closed by pushing in a piece of glass rod. The evolved gases being now retained in the tube pressed up the mercury in the longer limb, and it was from time to time drawn off by the outlet tube to prevent undue pressure on the stopper. When the decomposition was complete, which usually occurred in about 1½ hours (but in one case more than 2½ hours were required), the mercury was brought to the same level in both limbs and the space occupied by the gases was marked on the tube. A little mercury was then let out so as to make the pressure on the gas somewhat less than that of the atmosphere, and the space above the stopper was filled with hydrochloric acid diluted with a little water. The glass rod was then carefully withdrawn for an instant so that a few drops of the acid might enter the tube. The ammonia gas present was of course immediately absorbed, and the mercury having been again brought to the same level in both limbs, the space occupied by the residual hydrogen was marked on the tube. The volumes occupied by the gases were determined by finding the quantity of water required to fill them from a burette.

The following are the results of four experiments:—

No. of Experiment.	Volume of the Mixed Gases.	Volume of Residual Hydrogen.	Volume of Ammonia Absorbed.	Volumes of Ammonia found for one Volume of Hydrogen.
	c.c.	c.c.		
1	20·8	7·0	13·8	1·97
2	18·2	6·2	12·0	1·93
3	12·8	4·3	8·5	1·98
4	13·6	4·6	9·0	1·95

* Vol. ii., p. 162, 3me ed.
† *Annales de Chimie et de Physique*, ii., 16, Note.
‡ "Chemical Philosophy, p. 420.
§ *Phil. Mag.*, United Series, vol. xix., p. 97.
‖ *Silliman's Amer. Journal* [2], xl., 160.
¶ "Supp. Bd., vi., p. 346.

* Bakerian Lecture, 1809.

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I believe these figures are as nearly accordant with the atomic proportions as could be expected from the means employed, where the possible error in determining the volumes might amount to perhaps 0·2 c.c.

In another similarly conducted experiment, in which it was sought to obtain as much gas as possible, the tube was closed too soon, and the result showed a deficiency of ammonia, but is otherwise interesting:—

Experiment 5.

Volume of Mercury in the Amalgam.	Volume of Amalgam.	Volume of the Mixed Gases.	Volume of residual Hydrogen.
11·8	30·5	49·0	18·0

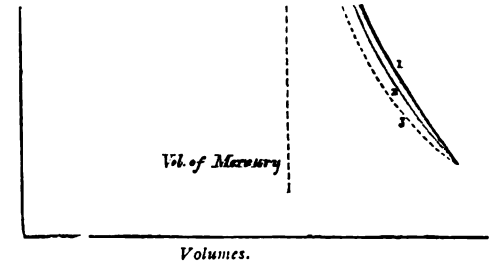
A new observation on the amalgam has recently been made in America by Professor C. A. Seeley,* who found, by subjecting it to varying pressure that its volume changes, apparently in accordance with Mariotte's law. He employed simply a glass tube fitted with a plunger, and did not measure the pressures or volumes. His conclusions were that the amalgam is a mechanical or physical mixture of liquid mercury with the gases ammonia and hydrogen, and that its semi-fluid consistence is due to the mixture having the nature of a froth.

Being desirous of submitting Seeley's remark on the compressibility of the amalgam to the test of direct measurement, I subjected the electrically formed amalgam to pressure in a glass tube 48 centimetres long, and 1·3 centimetres diameter. The pressure was applied by connecting the tube with a syringe, by which air could be forced into the apparatus, and the amount of the pressure was measured by a column of mercury in an open manometer. There was some difficulty in measuring the volume owing to the occasional escape of bubbles of gas, which caused abrupt alterations of the level. The results obtained are given in the following table, which also contains a column of volumes calculated on the supposition that the amalgam is a mere mixture of fluid mercury and gas, allowance being made for the pressure on the gas due to the column of mercury in the amalgam itself. The extreme case was assumed, namely, that this additional pressure is represented by a column of mercury half the height of the amalgam.

No. of Experiment.	Vol. of Mercury in the Amalgam.	Atmospheric Pressure in Centimetres of Mercury.	Vol. of Amalgam under Atmospheric Pressure	The Increased Pressure in Centimetres of Mercury.	Observed Vol. of Amalgam under Increased Pressure.	Calculated Vol. of Amalgam under Increased Pressure.
	c.c.		c.c.		c.c.	c c.
6	14·5	76·2	21·0	152·4	18·0	17·9
7	11·9	76·8	23·0	188·2	17·5	17·1
8	11·9	76·8	22·7	200·9	17·0	16·4
9	24·4	76·2	36·2	152·4	31·6	30·9
10	24·4	76·2	31·6	152·4	28·0	27·4
11	13·2	76·2	28·7	152·4	23·0	21·6
12	13·2	76·2	22·5	152·4	18·5	17·2
13	10·4	76·2	18·0	186·3	14·7	13·7
14	10·4	76·2	16·0	186·3	12·8	12·8
15	23·8	76·2	40·4	178·7	33·6	31·9
16	23·8	76·2	42·0	176·1	33·6	32·7
17	23·8	76·2	42·8	152·6	35·0	34·7
18	23·8	76·2	40·4	177·4	33·3	31·9
19	23·8	76·2	42·2	102·6	38·8	38·5
20	23·8	76·2	42·2	153·6	34·0	34·0
21	23·8	76·2	42·2	177·4	33·0	32·7
22	23·8	76·2	42·0	201·5	32·2	31·6
23	23·8	76·2	40·2	177·4	32·2	32·1
24	23·8	76·2	40·6	201·5	31·2	30·6
25	23·8	76·2	36·2	149·5	32·6	30·6
26	29·2	76·2	42·0	177·4	36·8	35·4
27	29·2	76·2	42·0	200·2	36·2	34·7
28	29·2	76·2	40·6	173·6	36·0	34·7
29	29·2	76·2	39·5	198·9	34·4	33·4
30	24·6	76·2	32·0	155·9	29·7	28·4
31	24·6	76·2	34·0	177·4	30·4	28·7

* CHEMICAL NEWS, June 10, 1870

Five points deduced from the mean results of experiments 15 to 24 having been laid down in relation to rectangular axes, the curve (1) which passed through them is represented in the diagram, which shows also the curve (2) through five points representing the calculated volumes, and a line (3) representing volumes corresponding to the



pressures which were applied to the top of the columns of amalgam.

The diagram and figures sufficiently show that the compressibility of the amalgam agrees nearly with the supposition of its being a mixture of gas and mercury, but that it is, however, somewhat less compressible. This, no doubt, is owing chiefly if not entirely to its want of fluidity.

I think that from these experiments I am warranted in drawing the two following conclusions, viz.:—

(1). In the fact of the gases being evolved in atomic proportions, we have the clearest proof that the ammonia and hydrogen are chemically combined.

(2). The compressibility of the mass proves that the enlarged volume or swelling up is due mainly, if not entirely, to free gases entangled in it.

In connection with the first of these conclusions arises the further question whether the NH_4 is combined with the mercury. That it is so combined appears in the highest degree probable from the apparently uniform diffusion of the NH_4 throughout the mass, and from the fact that such a union would be only one additional instance of the innumerable cases in which this radical plays the part of a metal. Seeley says, that if the radical NH_4 be contained in the amalgam at all, it must be in the state of gas. But the figures furnished by my fifth experiment show that if this supposed NH_4 gas had the normal molecular volume, and existed in the amalgam from the beginning, a force of two atmospheres would be required to compress it within the amalgam. The decomposition therefore is progressive, and points to the existence of a real compound of NH_4 with the mercury. We may therefore admit, that such a compound is originally formed, and decomposes rapidly into mercury, ammonia, and hydrogen, while the gases becoming entangled in the mass impart to it that remarkable turgescence, which is not, however, a property of the original compound (or ammonium amalgam), but merely an accidental result of its decomposition.

As to the cause of the retention of the gases, I am not prepared to offer an opinion, further than that its explanation would probably involve physical rather than chemical considerations.

I have to express my obligation to the kindness of Dr. Roscoe for the use of the appliances of the laboratory at Owens College, where the experiments were carried out, and I am also indebted to him for valuable suggestions.

Sir Humphry Davy, Bart.—A colossal statue, which has cost £600, has been erected to the memory of Sir Humphry Davy at Penzance, his native place. The statue is placed in front of the Post-Office, near to the birthplace of the great philosopher.

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NOTICES OF BOOKS.

Statements relating to the Home and Foreign Trade of the Dominion of Canada; also Annual Report of the Commerce of Montreal for 1871. By WM. J. PATTERSON, Secretary to the Board of Trade. Montreal: "The Gazette" Printing House. 1872.

Mineral Resources North of Port Augusta. Ordered by the House of Assembly to be printed and lithographed, April 17th, 1872.

Mineral Statistics of Victoria for the Year 1871. Presented to both Houses of Parliament by His Excellency's Command. Melbourne: John Ferres.

ALTHOUGH the first two reports do not include subjects that we can discuss, we must bear witness to the extreme care and accuracy with which the matter has been collated. In the third report, however, there is much that will interest our readers, especially in the laboratory report by Mr. J. Cosino Newberry, B.Sc., Analyst to the Mines Commission, under whose direction over one hundred analyses, examinations, and assays have been made during the past year. The mining assays have only a local interest, and we omit them—unwillingly, because of the care which they evince; but the analyses of rocks and minerals are too instructive to be so summarily disposed of. An analysis of halotrichite, from near Mudgee, N.S.W., crystallised in needles, and massive, colour white, shows the composition to be—

Alumina	11·67
Magnesia	4·41
Sulphuric acid	39·88
Cobalt	traces
Iron	,,
Soda	,,
Water	42·24
Silica	0·20
	98·40

A dense, flint-like rock, of yellow colour, occurring in granite, gave—

Silica	98·10
Alumina	1·77
	99·87

Fibrolite, from Gippsland, gave—

Silica	36·90
Alumina	60·73
Lime	0·63
Magnesia	0·33
Water	1·50
	100·09

Infusorial earth, from near Talbot, occurring in quantities, and of considerable value, gave—

Silica	83·88
Alumina	7·41
Lime	1·24
Magnesia	0·75
Water	6·23
	99·51

Fire-clay, bricks of which stand a high temperature without softening or cracking, the most extreme heat of an assay furnace being insufficient to round the thin edges, gave—

Silica	67·2
Alumina	29·0
Water	4·0
	100·2

Analyses were made with the view of ascertaining the nature of the so-called lava-streaks found cutting the silurian shales and sandstones in various rocks, and the results prove that they are more or less decomposed dyke-stones, probably basaltic. Of a rock, 51·78 per cent of which was soluble in hydrochloric acid, the soluble portion gave—

Water	13·81
Silica	8·81
Alumina	18·01
Peroxide of iron	8·80
Lime	2·34
Magnesia	trace
Potash	0·90
Soda	trace
Phosphoric acid	0·40
Soluble sulphates and chlorides	trace
	53·07

The excess in the analysis is probably due to the oxides of iron being determined as peroxides. They occur as protoxide, peroxide, and magnetic oxide. The insoluble 48·22 per cent consisted of—

Silica	33·75
Alumina	13·77
Lime	0·70
	48·22

Some experiments were made with the view of finding means of clearing the muddy waters of reservoirs. The purest waters are, as a rule, those in which mud and organic matter remain longest in suspension. Water from the Expedition Pass Reservoir stood in a bottle in the laboratory for more than six months without depositing the clay held in suspension. The soluble matter was chiefly chloride and carbonate of sodium, and was present in only small quantity. Another water stood for three months with like results. Both waters contained more clayey than organic matter, and were rendered clear by an addition of chloride of calcium. One part of this salt in 1000 of water cleared it in less than one hour; 1 part in 2500 of water, in five hours; 1 part in 5000, in six hours; 1 part in 10,000, in twenty-four hours. When, however, the water contained more organic matter than inorganic or clayey matter in suspension, the calcium salt did not act so readily, but was aided by an addition of lime: as little as two grains of quick-lime cleared a gallon of water in twelve hours. Three or four grains of alum or chloride of aluminum answered the same purpose; but there are many objections to the use of alumina salts.

We have selected but few of the tabulated results, the entire arrangement of which may be fully commended to the reader.

El Aqua del Rio de la Plata su Analisis Quimico con Observaciones sobre las Variaciones en su Composicion; in forme presentado á la Comision de Aquas Corrientes de la Ciudad de Buenos-Aires. Por JUAN J. J. KYLE, Catedrático de Quimico en el Collegio Nacional. Buenos-Ayres. 1872.

THIS small pamphlet contains valuable information as to the chemical composition of the waters of the rivers Rio de la Plata, Rio Parana de las Palmas, and that of the water supplied to the city of Buenos-Ayres. The author has analysed the water of the above rivers at various depths and in various states of the tide. The result of this analysis he gives in two tabulated forms, from which it appears that the water tested was of medium purity, as also was that supplied to Buenos Ayres.

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The method of analysis used was that recommended by Messrs. Wanklyn and Chapman.

CORRESPONDENCE.

VANADIUM IN TRAP-ROCKS.

To the Editor of the Chemical News.

Sir,—I trust you will allow me a little space in your paper for some observations on the prospective importance of such researches as those of Mr. Apjohn, published in your last issue. The earlier chemical history of rock masses was confined to empirical analysis, including only the most common elements. Two important steps have been taken in advance—one by Professor Haughton, the other by Bunsen. The former showed, by the discussion of his analyses of felstones, that these may be regarded as mixtures of orthoclase and quartz. Bunsen deduced a theory, from his examination of the igneous rocks of Iceland, that all such rocks may be referred to two types, some belonging to one type, some to the other, and the remainder being mixtures of the two in various proportions, the proportions being determinable by analysis. There are trap-rocks in the Isle of Man which cannot be brought within the scope of Bunsen's formulæ; but this proves nothing against the *idea* involved—it only shows that Bunsen's experiments did not cover ground enough to enable the formulæ of the two fundamental types to be determined. The third great step which, as it seems to me, remains to be taken, is that foreshadowed by the work of those who, like Mr. Apjohn, seek for the rarer elements in common stones.

Geologists divide all rocks into two classes, the igneous and the aqueous. The aqueous rocks, being derived from the igneous, must, viewed generally, have the same ultimate chemical composition, *minus* what has been washed out by water. The difference between the two kinds of rocks accumulates in the sea in the form of salts held in solution. Some of these salts must have gone on accumulating in the sea since water first began to condense upon the solidifying poles of the once fluid earth; other of the salts have continually been segregated out by organisms, to form the carboniferous strata. As the igneous rocks which protrude through the older strata rarely contain carbonic acid, it seems reasonable to suppose that nearly all the carbonic acid contained in the sea-deposited carboniferous rocks was once atmospheric. If so, the pressure of the atmosphere must, in early geological eras, have been enormously greater than it now is, and consequently the early sea have been once at far above the temperature at which water now boils. The powerful chemical action of water heated under pressure in an atmosphere of carbonic acid has been often insisted upon as a means of accounting for the large proportion of salts contained in some mineral waters. The decomposition of the alkali and alkali-earthy silicates of the primordial earth-surface must therefore have proceeded at a far more rapid rate in early ages than in later times. Meanwhile the more soluble constituents were constantly being dissolved out of the rocks, in part to go on accumulating in sea-water to this day, and in part to furnish the cases or skeletons of organisms, which to this day are being deposited to form ocean bottoms. Speaking generally, the insoluble residue ultimately left of the igneous rocks, after repeated denudation, re-melting, degradation, and re-deposition, would be mainly a silicate of alumina or clay. It is common with geologists to speak of all these rocks as if their ultimate composition were the same; but the well-known difference in fusibility between the aqueous and the igneous rocks is alone sufficient to show that the composition is different, and different in the direction that might have been predicted.

If the proportion of, say lime, in the oldest igneous and the newest sedimentary rocks were known, the difference would be represented by the lime present in those carboniferous strata that have been formed by organisms out of the sea, taken together with the comparatively insignificant portion remaining in solution. If the total quantity of lime so segregated were known, the mass of original igneous rock acted upon might be calculated. Such data cannot be obtained; but if we take, say vanadium, and ascertain, by sufficiently numerous experiments, an approximation to the proportion of it contained in the oldest igneous rocks, and prove either its absence, or determine its proportion, in the later sedimentary rocks, then we may look in the existing sea for the whole of the difference. Now it is very easy to detect vanadium in sea-water, and it could not be very difficult to determine the proportion in which it is present. This once known, the total quantity contained in the ocean could be roughly calculated, and hence the total thickness of original earth-crust that had been acted upon by the sea. Such a calculation could be verified or controlled by the discussion of the data afforded by corresponding experiments, as to the proportions present in the two kinds of rock and in sea-water, of other elements, as iodine or osmium.

I have assumed in this argument that the earth's crust was originally homogeneous, of the same chemical composition throughout, with the rarer elements equally diffused. This assumption is not, however, essential for the end in view, provided an average composition can be established for the older igneous rocks. Many of the trap-rocks are doubtless only sedimentary rocks re-melted. Most are probably a mixture of re-melted aqueous rocks, with original earth-crust. Other things being equal, those igneous rocks which protrude in great mountains through the older sedimentary strata, and which possess a great equality of composition all round, would be most likely to represent the original earth-crust. Such a mountain is that of Penmaenmawr, in North Wales. The rock known as Rowley Rag, near Birmingham, closely resembles it in chemical character. By a comparison of a sufficient number of specimens of such rocks from different localities, with respect to the proportion—say of vanadium—contained in them, it would become known how far such proportion might be trusted as an indication of the original constitution of the rock. Further examination of specimens from trap-dykes traversing more recently deposited rocks would show if the proportion of the vanadium was less in such; and ultimately the true proportion contained in the original crust would be inferred, together with a means of judging of the origin of traps and basalts. If such a result were not obtained, even, it would be worth while to know that the contrary proposition was true,—that the composition of the earth's crust was not originally homogeneous; and one or the other conclusion must result from sufficient investigation, conducted as here suggested.

But the assumption of the original homogeneity of the earth's crust is not without facts in its support. The search after the rarer elements has not been diligent enough, nor are the methods of detecting them, when present in small proportion, effective enough, to justify any conclusion as to their total absence from ordinary rocks. Some of the elements most sought after, and others the means of detecting which are extremely delicate, are known to be almost universally diffused. Gold, silver, copper, and iodine, come into this category. Platinum appears to have been found whenever sought for in the larger masses of igneous rocks. The mountains of Auvergne, in France, are known to contain it throughout. It is present in the Penmaenmawr rock, and in all the clays I have ever examined for it, which are many. The close general chemical resemblance between great masses of igneous rocks, all the world over, is well recognised. What is now needed is, to trace the rarer elements through all these, and to follow up their disappearance—for such of them as do disappear—into the later sedi-

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mentary rocks. Then the elements missing in the latter should be found in sea-water.

The great diversity of minerals, the accumulation of rare elements in special localities, and the various dominant mineral characteristics of different countries, furnish no valid argument against the position here taken. For what forces have been at work! and for how long? The most complex and rare of minerals are found just where they might be expected to be found—in high latitudes. For then great geological changes must first have begun, and gone on under the influence of water, while as yet no crust was formed in equatorial regions, since astronomers tell us that the axis of the earth has not changed its position from the earliest times, except within the swing of the precession of the equinoxes. It seems as if all accumulations of special minerals had taken place very gradually, and under influences which, however obscure, are not utterly unintelligible. Mineral veins are usually found in the neighbourhood of faults, which, by causing the formation of cavities, determine the drainage from, it may be, miles of superincumbent rock, and from a surface hundreds of miles in extent. When we consider that from any ordinary piece of slate (and still more of a trap-rock) traces of metals, precipitable from acid solution by sulphuretted hydrogen, may always be obtained, it is not wonderful that the drainage from probably hundreds of cubic miles of rock, all converging to one axis, should fill up cavities with deposits of minerals in abundance, the elements of which can only with difficulty be detected in the parent rock. Then either denudation of miles of superincumbent rock, or upheaval, or alternations of both, proceeding through geological eras, make such deposits accessible, and at the same time make the origin obscure. Vanadium appears to be an element the estimation of which in rocks is well adapted for the purpose of distinguishing between the two great classes of rock, with their varieties. It must be an element that water extracts with some ease, or the sea could not contain so much as that a tumbler full of sea-water should suffice for its detection, while it is classed among the rarest of terrestrial elements. —I am, &c.,

E. SONSTADT.

Ramsey, Isle of Man,
October 21, 1872.

PS.—I have referred to the detection of vanadium in sea-water; and, although it is well known that vanadium must be there, since it is found in crystals from the mother-liquors of the soda manufacture, yet it may be expected that I should state the method I have followed of directly detecting it. If to a specimen of sea-water about a fourth of its volume of a saturated solution of pure iodate of potassium is added, after a few hours a precipitate forms, consisting essentially of iodate of calcium, but containing vanadium, and giving the usual blowpipe reactions of vanadium. I have used other methods, but this is the best.

A great number of salts, more or less soluble in pure water, are totally insoluble in a strong solution of iodate of potassium. Didymium, for instance, is so completely precipitated by this reagent, that the filtrate gives, through a thickness of several inches, no trace of absorption lines in the spectroscope. The alkalies, magnesia, alumina, and glucina, are not precipitated. Stas had difficulty in procuring iodate of potassium that remained colourless on exposure to the air. But if a solution of iodate of potassium is concentrated sufficiently to crystallise slightly, every trace of impurity capable of causing colouration of the crystals goes down with the first crop; and subsequent crops of crystals are snowy-white and permanent in the air, and do not give a coloured bead before the blowpipe. The precipitate which iodate of potassium gives with sea-water appears to contain osmium as well as vanadium, and even in larger proportion. If alcohol is added to the sea-water a few hours before the addition of the iodate, the precipitate is free from both vanadium and osmium. —E. S.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, October 21, 1872.

In addition to a large number of original memoirs and papers relating to mathematics, physics, geography, meteorology, applied and pure mechanics, and astronomy, this number contains the following original paper relating to chemistry:—

Action of Crystallised Sugar upon the Cupro-Potassic Reagent of Barreswil.—E. Feltz.—After first observing that the estimation of glucose is based upon the reduction of the cupro-potassic liquor heated to ebullition, the author states that it has been inferred that refined and crystallised sugar exerts no action upon the reagent alluded to, and describes at length a series of experiments from which it appears that pure and best refined sugar also gives the well-known reaction—viz., separation of sub- or red oxide of copper, especially in the presence of an excess of alkali. While the author remarks that Dr. Scheibler pointed out in 1869 that the estimation of glucose is vitiated in a mixture of the two sugars under certain conditions, he forgets that many years ago the late Dr. G. J. Mulder, in an essay on sugar, proved that the cupro-potassic test fails unless it is carefully prepared, and that no higher temperature than about 80° or 90° should be applied; as above that temperature even the cupro-potassic liquor alone is liable to reduction (see *Jahresbericht über die Fortschritte der Chemie, von J. v. Liebig und H. Kopp, für* 1850, pp. 614, 675, 676).

La Revue Scientifique de la France et de l'Etranger, October 26, 1872.

This number contains no original papers relating to chemistry, but we call attention to the following memoirs:—

Geology of the Secondary and Tertiary Basins of the Sub-Cévennic Region (Région sous Cévennique).—Dr. Bleicher.—Illustrated with woodcuts and diagrams.

Glycogenesis in the Invertebrate Animals, and General Character of Nutrition and Glycogenesis.—Dr. C. Bernard.—The continuation of a series of lectures on general physiology.

Neues Jahrbuch für Pharmacie und Verwandte Fächer, von Dr. F. Vorwerk, January, 1872.

This number (which has been delayed in transmission) contains the following original papers relating to chemistry:—

Analysis of Potable Waters by means of a Titrated Soap-Solution.—Dr. Graeger.—The detailed account of a peculiar volumetric method of water analysis by means of an alcoholic soap-solution of known strength. It appears from the results of this method, as compared with the gravimetric method, that for practical purposes this plan of analysis is sufficiently correct to estimate the carbonate of lime, lime, magnesia, sulphuric acid, chlorine, and carbonic acid in drinking water.

Formation of Corrosive Sublimate in Powders Containing Calomel.—G. Vulpius.—The author has instituted a series of experiments to ascertain the correctness of the assertion that calomel when mixed with other powders becomes converted into corrosive sublimate; the results of these researches may be summarised as follows:—No corrosive sublimate is formed within twenty-four hours when calomel is mixed with saccharum album, saccharum lactis, magnesia usta, magnesia hydrico-carbonica, and natrium bicarbonicum. After three months no corrosive sublimate is formed in mixtures of calomel with magnesia usta, magnesia hydrico-carbonica, and any kind of refined sugar or milk-sugar, but faint traces are formed in mixtures containing calomel, natrium bicarbonicum, and refined lump-sugar. By treatment with water, corrosive sublimate is only formed in such mixtures of calomel as contain magnesia usta and bicarbonate of soda. Rather large quantities of sublimate are formed in powders composed of calomel, sugar, and bicarbonate of soda, if the mixture becomes damp and is kept for a long time. No sublimate is formed when a powder consisting of calomel and bicarbonate of soda is digested with water acidulated with hydrochloric acid. Pepsin does not favour the formation of corrosive sublimate.

Hager's Method for the Quantitative Estimation of the Cinchona Alkaloids by means of Picric Acid.—O. Medin.—This essay treats at great length on the quantitative estimation of the cinchona alkaloids by precipitation with a solution of picric acid; the quantity of alkaloids present in cinchona barks may thus be readily and accurately ascertained.

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February, 1872.

This number contains no original papers relating to chemistry.

March, 1872.

Some Double Salts of Protoxide of Iron, and their Applicability for Titrating the Solution of Permanganate of Potassa.—Dr. Graeger.—This essay contains the detailed account of the behaviour of the following double salts of iron with permanganate of potassa solution of a known strength:—Sulphate of protoxide of iron and ammonia, potassa, soda, magnesia, and oxide of zinc.

Some Reactions of Quinine and Morphine.—F. A. Flückiger.—The results of the author's researches may be summarised as follows:—The thalleiochin reaction is limited to from 1-4000th to 1-5000th; Vogel's reaction with ferrocyanide of potassium is not so sensitive. Very dilute solutions of quinine are best detected by the bromine reaction, which indicates even 1-20,000th of the alkaloid; by means of chlorine-water and ammonia, 1-1000th part of morphine may be detected, while the iodic acid reaction is ten times more sensitive. Bromine and ammonia are useless for the detection of morphine; in a mixture of salts of quinine and morphine, the test for either of these bases may be called forth at will by means of chlorine and ammonia.

April, 1872.

Preparation of Pure Hydrochloric Acid.—Th. Diez.—The crude hydrochloric acid of commerce is first diluted, by the addition of water, to a sp. gr. of from 1·14 to 1·13, and it is next treated with sulphuretted hydrogen gas until it smells strongly of the gas. The liquid is next filtered, and then poured into a tabulated retort and heated until the sulphuretted hydrogen is eliminated. The test of solution of corrosive sublimate having been applied, the bulk of the acid is distilled over at a gentle heat, a few fluid ounces only being left in the retort, so that any chloride of iron left in the acid may be retained.

Quantity of Starch contained in Different Varieties of Potatoes.—Dr. Raab.—The tabulated form containing the record of experiments with sixty-one different varieties of potatoes, in which the author has estimated the total percentage of dry substance and the total quantity of starch. It appears from this research that the percentages alluded to vary, for dry matter, from 15·64 to 34·25, and the percentage of starch from 8·79 to 26·09.

Mejillones Guano.—H. Vohl.—This material occurs native and in large quantity near the Bay of Mejillones (Bolivia). In 100 parts, this substance consists of—Lime, 30·6636; magnesia, 7·9193; peroxide of iron, 0·1466; alumina, 0·0047; potassa, 0·5051; soda, 1·4532; phosphoric acid, 35·86803; chlorine, 2·2250; sulphuric acid, 1·6036; silica, 0·0459; carbonic acid, 1·5926; water driven off at 100°, 7·6858; non-nitrogenous organic matter, 6·5189; nitrogen, 0·7675; granules of granite insoluble in HCl, 2·2830; loss, 0·7249. The author states that this guano occurs in pulverulent sandy state, and that it is readily acted upon by carbonic acid and water, and thus rendered available for plants, while, in consequence of its high percentage of phosphoric acid, it may be used with advantage for the preparation of phosphate of ammonia and other phosphatic preparations.

May and June (double number), 1872.

This number contains no original matter relating to chemistry.

The American Journal of Science and Arts, October, 1872.

This number only contains one original paper relating to chemistry:—

Results of a Chemical Investigation of some Points in the Manufacture of Malleable Iron.—Russell W. Davenport.—Reserved for full reproduction.

This number contains several important papers relating to natural history, geology, astronomy, and physiology.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, June, 1872.

On Hypophosphites.—C. Rammelsberg.—This monograph has been already alluded to (see Chemical News, vol. xxvi., p. 23).

Behaviour of the Diamond and of Graphite when Strongly Heated.—G. Rose.—This essay, illustrated by several engravings, is divided into the following sections:—Ignition of diamond without access of air; ignition of diamond with access of air; on the peculiar and regular impressions which are formed on the diamond during its combustion; on the so-called carbonado (a peculiar variety of diamond found in Bahia); behaviour of graphite when ignited.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, June 27, 1872.

We receive this periodical very irregularly, this number having only just arrived.

Preparation of Sugar Colour from Glucose.—M. Krothe.—The detailed description of the industrial method of converting glucose into caramel, simply carried on by heating the glucose, which is largely made abroad by the action of sulphuric acid upon starch in boiling-water, with the addition of a small quantity of carbonate of ammonia, the materials being well stirred and carbonisation prevented. This kind of caramel is largely used to give a fictitious strength to beer.

Industrial Preparation of Hydrogen.—M. Giffard.—By first reducing to the metallic state a peculiar kind of iron ore found at Chateauroux (France) by means of oxide of carbon, finely-divided iron is obtained, which is used to prepare hydrogen, which thus costs only ½d. per cubic metre (35·31 English cubic feet) and may be used for various heating, illuminating, and air-balloon filling purposes.

Applications of Sulphurous Acid Gas.—M. Chaudet.—The author proposes to apply sulphurous acid gas—obtained in the usual way from pyrites or burning sulphur—for the purposes of saturating urine, the contents of *fosses d'aisance*, ammoniacal gas-water, the waste soap-water from woollen and other industries, partly for disinfection, but more particularly for obtaining valuable products by evaporation; the sulphurous acid gas is forced into the liquids by means of blowing-vans or force-pumps.

Note on the Determination of the True Zero of Thermometers.—Ch. Tellier.—Reserved for full translation.

American Journal of Pharmacy, October, 1872.

This number contains the following original papers relating to chemistry:—

Soluble Sulphate of Quinine.—J. Donde.—150 grms. of the ordinary sulphate of quinine are taken, and gradually put into a mixture of 22 grms. of concentrated sulphuric acid and 2 litres of water; this mixture is occasionally agitated until solution has taken place, and, after filtering, the fluid is concentrated by evaporation until the liquor is reduced to 600 grms.; the crystals are taken out twenty-four hours afterwards, and the remaining mother-liquor is again evaporated in order to obtain more crystals.

Preparation of the Bromides of Quinine, Morphine, Strychnine, and Calcium.—G. Macdonald.—The bromides of the alkaloids may be readily prepared on the small scale by precipitating the solutions of their neutral sulphates with bromide of barium, the latter to be prepared by saturating hydrobromic acid with carbonate of baryta; the bromide is very soluble, and it is not necessary to crystallise the solution. The bromides of the above-named alkaloids may be prepared for pharmaceutical purposes by a similar method. As regards bromide of calcium, the author directs to prepare it by double decomposition, aided by boiling a solution of bromide of ammonium, to which milk of lime (the lime to be made from pure white marble) is added, until ammoniacal vapours cease to be evolved; the salt is very deliquescent and requires to be kept in well-stoppered bottles.

Occurrence of Amygdalin, and Generation of Hydrocyanic Acid.—S. Henschen.—The author instituted a number of experiments by which he proved the presence of hydrocyanic acid by means of paper dipped in tincture of guaiacum and a solution of sulphate of copper, carefully avoiding ammoniacal vapours. Amygdalin treated with the meal of peas and of rye yielded hydrocyanic acid, but none with sifted wheat-flour. Sweet almonds were found to contain a minute quantity of amygdalin. The seeds of apples, pears, quinces, *Sorbus aucuparia*, *Sorbus latifolia*, all yielded HCy; traces of that acid were obtained from vetches. The generation of HCy from vegetables is generally regarded as conclusive evidence of the presence therein of amygdalin, but Dr. Peckolt ("Analyses de Materia Medica Brasiliera," Rio Janeiro, 1868) was unable in fifteen cases to prepare amygdalin from the root of the *Manihot utilissima* (the arrow-root plant) which copiously generates hydrocyanic acid with water. Vetches yield, instead of amygdalin, a new crystallisable body, $C_8H_{16}N_4O_8$. It would appear from some of the author's experiments that amygdalin may occur in plants without the simultaneous presence of emulsin; to ascertain the presence of amygdalin, the vegetable material is finely powdered, the acid which may be present is neutralised by chalk, some coarse rye-meal or a similar ferment is added, and then some water, after which the fermentation is allowed to proceed, and the presence or absence of HCy established as mentioned above.

Manufacture of Olive Oil in California.—Dr. J. M. Maisch.—It appears from the contents of this essay that the cultivation of the olive tree is very successful, and that the preparation of olive oil is becoming a leading industry in California.

Cotton-Seed Oil.—Dr. J. M. Maisch.—The preparation of this oil is carried on to a very large extent in some parts of the United States, 150,000 tons of seed being used annually; the oil-cake is largely exported to England, and the oil goes mostly to Bordeaux, Barcelona, and other olive-growing parts of Europe, from whence, after refining, it comes back as pure olive oil; a large proportion of raw cotton-seed oil is refined in London, and thence exported.

Les Mondes, October 24, 1872.

Obituary.—We learn with regret the demise of the celebrated physicist Jaques Babinet, who died on October 21, aged seventy-eight, having been born at Lusignan on March 5, 1794. The deceased savant was well and deservedly known as an excellent mathematician and physicist.

Deposits of Phosphatic Minerals at the Locality Known as the Perte du Rhone.—L. Grasser.—In a letter addressed to MM. Lomer and Ellershausen, at Geneva, the author, who is an inspector of mines, gives a detailed account of several deposits of phosphatic minerals met with on and near the spot where the river Rhone enters French territory. The mineral, both mineralogically and palæontologically, differs from coprolites and phosphatic nodules, consisting, in fact, of shells, the interior of which is filled with phosphate of lime. A sample found at Lancrans gave on analysis, in 100 parts—Phosphate

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of lime, 70·6; carbonate of lime, 15·0; insoluble matter, 12·0; bituminous matter and water, 2·4. A fragment from a nautilus from Mussel, gave, in 100 parts—Phosphate of lime, 65·3; carbonate of lime, 26·0; insoluble matter, 5·0; bituminous matter and water, 3·7. According to careful surveys, the total quantity of phosphatic mineral in this district amounts to 8,800,000 tons.

Although not strictly belonging to chemistry, we call attention to the following paper:—

Apiculture, a Method of Treating Bees for the Purpose of Safely Extracting the Honey and Wax from the Hives.—V. Meunier.—The author describes at length a process of administering chloroform to bees.

Absorbent Power of Phosphorus.—F. Sestini.—The author observes that when iodide of ethyl is made by Dr. Frankland's or Dr. Kopp's process there is left a solid brown-red to orange-brown residue, which is found to be amorphous phosphorus. The author says that this substance retains several metalloids, but especially iodine, even after having been repeatedly treated with boiling ether and then with a boiling solution of caustic potassa, while phosphuretted hydrogen is given off. There is left in the liquid much iodine; one sample was found to contain as much as 3·369 per cent. It appears, also, that the amorphous phosphorus (the residue from the preparation of iodide of ethyl) retains sulphur after having been treated with sulphide of carbon for the purpose of eliminating the ordinary white phosphorus; this sulphur is due to an incipient decomposition of the sulphide when in contact with the amorphous phosphorus at a higher temperature. According to the author, phosphorus exerts this absorbent power either by porosity (surface attraction) similar to that of charcoal and bone-black, or in the same manner as benzoic acid is retained by benzoin resin when the latter is used by the well-known process for the preparation of that acid.

Passivity of Cadmium.—M. Schoenck.—When cadmium is immersed in strong nitric acid (sp. gr., 1·47) it is readily dissolved, but when a spiral of platinum wire is tightly wound round the cadmium the latter is not acted upon by the nitric acid unless the acid is diluted with water.

International Congress for Weights and Measures.—M. Tresca.—The International metre will be constructed (viz., the standards) of an alloy of 90 parts of platinum and 10 of iridium, with a toleration of 2 per cent *plus* or *minus*; these standards will be verified at 0°, and copied exactly from the standards deposited in the Archives of the French Academy. The standard kilo. will be made of the same material, and also copied exactly from the standard deposited in the Archives of the Academy. The execution of the standards is entrusted to the French members, assisted by a permanent committee elected from the foreign members of the Congress; this committee will be composed of twelve members, five being a quorum. The members of the Congress have agreed to state to their respective Governments that it is desirable to establish a permanent International Bureau for Weights and Measures at Paris.

Polytechnisches Journal von Dr. E. M. Dingler, second number for September, 1872.

This number contains ollowing original papers and memoirs relating to chemistry and coll teral subjects:—

Improved Construction of Prony's Dynamometer.—C. Wersin.—The detailed description, illustrated by engravings, of an improved contrivance for ascertaining the dynamic force of machinery.

Peculiar Boiler Deposit Formed in the Steam-Space of a Boiler.—E. Mategczek.—The author relates a peculiar formation of a boiler deposit in the space not filled with water, but with steam. The sp. gr. of this material was found to be 1·388, and its chemical composition, in 100 parts, as follows:—Water, 2·831; fatty matter, 1·430; organic matter, 21·995; silica, 21·713; sulphuric acid, 6·947; chlorine, 0·139; oxide of iron, 3·836; phosphoric acid and alumina, 7·878; lime, 15·752; magnesia, 4·151; sand and clay, 12·283. The water used as feed-water for this boiler was taken from the river Elbe, but the large proportion of organic matter is in a measure due to the fact that the feed-water is taken from the condensed hot water from the air-pumps, the boiler being used in a beet-root sugar-works and refinery.

Estimation of Oxygen in the Decarbonised Bessemer Metal before the addition thereto of the Specular Iron, on the Action of that Iron and a Substitute for it, and the Means of Producing a Bessemer Casting without being Honeycombed.—Dr. A. Bender.—An essay strictly treating on the practice of sidero-metallurgy.

Journal für Gasbeleuchtung und Wasserversorgung, No. 18, 1872.

This number only contains matter relating to gas- and water-works' engineering and management.

NOTES AND QUERIES.

Transparent Cement.—(Reply to "Omicra."—You will find the information in the English edition of Wagner's "Chemical Technology," recently published by Messrs. J. and A. Churchill.

Oxychloride of Magnesium Cement.—Will any correspondent who has made this cement oblige by publishing the process; I have never been able to make it satisfactorily, nor have I met with anyone who has used it with success. The fact of its existence has been published so often as to leave no doubt of the possibility of making it. —T. F.

Sugar Refining—Works on Organic Chemistry.—(Reply to A. J. W.)—Consult "Traité Complet Théorique et Pratique de la Fabrication du Sucre Guide du Fabricant," par Charles Stammer (Paris: E. Lacroix). Among the large number of excellent works on organic chemistry published in different languages, we mention "Ausführliches Lehrbuch der Organischen Chemie," von Dr. H. Kolbe (3 vols.). These works may be inspected at the Patent Office Library. "Chemisch-Technische Mittheilungen," by Dr. Elsner; annually; 19 vols. published. "Jahresberichte über die Liestungen der Chemischen Technologie," by Dr. Wagner; 17 vols.; published annually. "Index to Foreign Scientific Periodicals contained in the Free Public Library of the Commissioners of Patents" (7 vols.).

PATENTS.

Communicated by Messrs. VAUGHAN and SON, Patent Agents, 54, Chancery Lane, London, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

2476. A. Deiss, Plaistow, Essex, "A new or improved process of percolation for the purpose of extracting fatty, resinous, and similar matters."—Petition recorded August 20, 1872.

2712. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in effecting the purification of cast-iron, malleable iron, cast-steel, and malleable steel, and other metals or alloys."—A communication from J. B. L. Forquignon, Nancy, and L. M. Ehrmann, Paris, France.—Petition recorded September 12, 1872.

2746. E. T. Hughes, Chancery Lane, Middlesex, "The treatment of greasy and washing liquors used in scouring or cleaning wool by caustic baryta or strontia."—A communication from L. G. G. Daudenart, and E. Verbert, Rue du Progrès, Schaerbeck, Brussels.—Petition recorded September 16, 1872.

2822. C. Morfit, Baltimore, U.S.A., "Improvements in the reclamation of materials employed in the manufacture of di-phosphate and tri-phosphate of lime."—Petition recorded September 24, 1872.

2913. H. B. Barnett and W. B. M. Slade, Gracechurch Street, London, "Improvements in the preparation or production of disinfecting, antiseptic, and cleansing liquids."—Petition recorded October 3, 1872.

2930. J. G. N. Alleyne, Alfreton, Derbyshire, "Improvements in apparatus for the manufacture and refining of sugar and rum, or other spirit."

2934. H. B. Barnett and W. B. M. Slade, Gracechurch Street, London, "Improved manufacture of fluids for deodorising and disinfecting purposes."—Petitions recorded October 4, 1872.

2941. G. Robbe, Fenchurch Street, London, "A medical preparation applicable to the treatment of what is known as 'Foot and mouth disease' in cattle."—A communication from J. M. Brunet, Dieppe, France.

2943. E. J. Payne, Packwood, Warwickshire, and W. Clarke, Dudley, Worcestershire, "Improvements in converting or partially converting iron into steel."—Petitions recorded October 5, 1872.

2947. J. Macintosh, Bayswater, and W. Boggett, Chelsea, Middlesex, "Improvements in treating and applying animal membranes, and in constructing articles therewith, comprising vessels to contain air, and in valves for inflating the same, which valves are applicable to other useful purposes."—Petition recorded October 7, 1872.

2959. W. Lorberg, North Bow, Middlesex, "A new or improved process for the manufacture of soap."

2964. H. Lonkin, Theydon-Gernon, Essex, A. Leighton, South Castle Street, Liverpool, and W. White, Thurlow Road, Hampstead, Middlesex, "Improvements in the production of iron and steel."—Petitions recorded October 8, 1872.

2974. B. Tanner, Liverpool, "Improvements in the manufacture of artificial manures."—Petition recorded October 9, 1872.

2982. J. Hargreaves and T. Robinson, Widnes, Lancashire, "Improvements in the manufacture of alkalies, and in apparatus employed therein."

2989. J. Young, Kelly, Renfrewshire, N.B., "Improvements in the manufacture of carbonate of soda."

2995. J. H. Dickson, Harefield, Middlesex, "An improved process of and machinery for treating or preparing fibre-yielding plants for the purpose of obtaining useful fibres therefrom."—Petitions recorded October 10, 1872.

2997. J. W. Perkins, Brixton, Surrey, "The manufacture of artificial fuel."

3003. J. Steedman, Glasgow, N.B., "Improvements in obtaining acetic acid."

3005. C. Lowe, Reddish, Lancashire, "Improvements in the treatment of coal-gas tars for the purpose of obtaining certain useful products therefrom."

3007. E. C. Nicholson, Kennington Road, Surrey, "Improvements in the separation of substances and products capable of being employed for the purposes of dyeing and printing."—Petitions recorded October 11, 1872.

3040. P. Maccallum, Dunfermline, N.B., "A new or improved artificial fuel."—Petition recorded October 15, 1872.

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NOTICES TO PROCEED.

1722. T. Gray, New Wandsworth, Surrey, "Improvements in the means of treating vegetable fibres for the manufacture of paper."—Petition recorded June 7, 1872.

1723. J. J. Harrop, Manchester, and W. Corbett, Bradford, Lancashire, "Improvements in puddling iron and in puddling furnaces."—Petition recorded June 7, 1872.

1742. C. A. Faure, Brook Street, Lambeth, Surrey, "Improvements in the process or processes of applying electric currents to chemical decompositions and combinations, including the manufacture of alkalies."—Petition recorded June 10, 1872.

1743. O. Doyen, Reims, France, "An improved preparation and utilisation of coffee in the form of tablets for food."—Petition recorded June 10, 1872.

1769. J. Dupont, Nimes, France, "The application and treatment of certain plants not hitherto used for the production of filaments and fibres."—Petition recorded June 12, 1872.

2144. S. S. Bateson, Bolton Street, Mayfair, Middlesex, "Improvements in the treatment of hides or skins."—Petition recorded July 17, 1872.

2712. J. H. Johnson, Lincoln's Inn Fields, Middlesex. "Improvements in effecting the purification of cast-iron, malleable iron, cast-steel, and malleable steel, and other metals or alloys."—A communication from J. B. L. Forquignon, Nancy, and L. M. Ehrmann, Paris, France.—Petition recorded September 12, 1872.

2790. R. Stone, Liverpool, "An improved artificial fuel."—Petition recorded September 20, 1872.

2845. F. Walton, Staines, Middlesex, "Improvements in oxidising oil, and in machinery to be employed for that purpose."

2847. C. W. Harrison and A. H. Harrison, High Holborn, Middlesex, "Improvements in combining atmospheric air and certain gases for lighting and heating purposes."—Petitions recorded September 26, 1872.

2861. C. W. Siemens, Great George Street, Westminster, "Improvements in the process for the production of iron and steel, and in furnaces or apparatus employed for that purpose."—Petition recorded September 28, 1872.

2950. T. Greener, Darlington, and W. Ellis, Gateshead, Durham, "Improvements in the manufacture of iron and in the production of 'fetling' for improving the quality and yield of iron in the process of reduction."—Petition recorded October 7, 1872.

2964. H. Larkin, Theydon Gernon, Essex, A. Leighton, South Castle Street, Liverpool, and W. White, Thurlow Road, Hampstead, "Improvements in the production of iron and steel."—Petition recorded October 8, 1872.

PATENTS SEALED.

1171. J. Barrow and C. J. Crosfield, Liverpool, "Improvements in utilising certain saccharine syrups, and in apparatus employed therein."—Dated April 19, 1872.

1263. W. A. Lyttle, Hammersmith, Middlesex, "Improvements in the preparation and utilisation of bituminous asphalte."—Dated April 27, 1872.

1293. C. Duff, Wandsworth Road, Surrey, "Improvements in the treatment of fibrous substances to be used in the manufacture of pulp for paper, and for conversion into spun and textile fabrics."—Dated April 30, 1872.

1307. L. Bradley, Rotterdam, Holland, "Improvements in the manufacture of cement."—Dated May 1, 1872.

1468. J. Spratt, Camberwell, Surrey, "A new or improved food for cats."—Dated May 14, 1872.

1476. R. C. Menzies, Valleyfield, Midlothian, N.B., and A. E. Davies, Worcester, "Improvements in the manufacture of pulp for paper-making."—Dated May 15, 1872.

1802. C. W. Smith, Highfield, near Stroud, Gloucestershire, "Improvements in the extraction of indigo and other similar substances from plants containing such substances.—Dated June 15, 1872.

2572. W. R. Lake, Southampton Buildings, London, "Improved compounds, chiefly designed for coating ships' bottoms."—A communication from J. H. Bloodgood, New York, U.S.A.—Dated August 29, 1872.

FOREIGN PATENTS.

ITALY.

1. L. Pasteur, "A new process for the manufacture of beer."—Dated September 4, 1871.

3. J. V. P. Lagrange, "Purifying and clarifying sugar-juice and syrup in sugar works.—Dated December 11, 1871.

4. E. Leconte, "Using starch of maize, rice, &c., in the manufacture of beer, alcohol, and other fermented liquors."—Dated January 2, 1872.

10. J. Bertram and Son, "Improvements in the manufacture of pulp of straw and other like fibrous substances, and in apparatus belonging thereto."—Dated March 26, 1872.

13. A. Ungerer, "A chemical process for obtaining wood pulp."—Dated February 17, 1872.

16. J. B. Muschamp, "Improvements in explosive substances, and process for manufacturing the same."—Dated March 29, 1872.

18. F. Terrachini, "Extracting sulphuretted hydrogen from the sulphur ores of Sicily."—Dated March 30, 1872.

PRUSSIA.

7. H. Jüngling, "An apparatus for manufacturing gas."—Dated *August 26, 1872.*

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THE CHEMICAL NEWS.

VOL. XXVI. No. 676.

DESCRIPTION OF A NEW QUINIMETRIC PROCESS.*

By P. CARLES.

HAVING ascertained, by experiment, that the quinimetric methods in use are not suited for extracting, in a sufficiently pure state to admit of weighing, all the quinine contained in the cinchona barks (the decoction method extracts colouring matter and changes the active principles, while the lixiviation process yields very weak liquors, in which a portion of the alkaloids are kept in solution), I have devised a method which may be carried out as follows:—A good average sample of the bark is ground to powder, and passed through a fine horse-hair sieve; 20 grms. of this powder are intimately mixed with from 6 to 8 grms. of slaked lime, mixed with 35 grms. of water, and the mixture of quina bark and pasty lime dried at a gentle heat; the cake thus formed is reduced to a coarse powder and pressed into a conically-shaped glass tube (or a funnel with stop-cock and glass stopper); chloroform is then gradually poured on to the contents, care being taken to cork the tube at the top: 150 grms. of chloroform will be a sufficient quantity, but it is best to ascertain if the bark is exhausted by evaporating a few drops of the last portion of the chloroform in a porcelain basin; the residue should be treated first with dilute sulphuric acid, and next with chlorine water and ammonia. The chloroform which adheres to the mixture of lime and bark is displaced by the addition of water, and the fluid is next evaporated upon a water-bath until a dry residue is left. If desired to save the chloroform, it can be distilled off in a retort upon a water-bath: the distillation should not, however, be carried on to dryness, but the remainder of the fluid is to be evaporated to dryness in a porcelain capsule, and then treated with dilute sulphuric acid. The solid dry residue consists of the alkaloids of the bark, mixed with about their own weight of waxy-resinous (*céréo-resineux*) matters; the alkaloids are taken up by dilute sulphuric acid (1 to 10), of which fluid from 10 to 12 c.c. are sufficient. This solution is filtered through a very small, previously moistened, filter, and the filtrate is colourless; the filtrate is next heated to 100° upon a water-bath, and, when hot, ammonia—at first concentrated, afterwards dilute—is added, so as to cause the filtrate to become very nearly saturated,—to be left very slightly acid; all the quinine will then crystallise in the shape of sulphate. This crystallisation proceeds rapidly, and the peculiar odour emitted by the fluid, as well as the aspect of the crystals, are of some value in ascertaining beforehand the quality of the bark operated upon. When the liquid has become completely cold the crystalline matter forms a solid cake, which has only to be placed upon a double filter for the purpose of draining; the mother-liquor is displaced by a few drops of water, after which the mass is gently pressed, dried, and weighed.† If the mother-liquor is found to be very acid, ammonia in slight excess should be added, for the purpose of precipitating the rest of the quinine. The other alkaloids remain in solution, and are next separated by precipitation, dried, weighed, and tested with washed ether.

This process is simple and expeditious, and yields good results, the quinine being obtained in a colourless state. I quote the following instances of its working:—(1). A mixture was taken of pure sulphate of quinine, 0·60; cinchonine, 0·20; dilute sulphuric acid (1 to 10), 10 c.c.; while hot I poured, by means of a pipette, first concentrated and then dilute ammonia nearly to saturation: result obtained—sulphate of quinine, 0·59; cinchonine, 0·22. (2). Sulphate of quinine, 0·50; cinchonine, 0·25: acid at $\frac{1}{10}$, 10 c.c., found sulphate of quinine, 0·52; cinchonine, 0·17. A. Yellow cinchona bark, 20 grms. has yielded per 1000, by the use of Rabourdin's modified process (see *Journ. de Pharmacie*, 1861), strongly-coloured crystalline sulphate of quinine, 23·00; with Le Maitre's process, somewhat yellow-coloured sulphate of quinine, 22·30; with my process, colourless sulphate of quinine, 26·55. B. Yellow cinchona bark, same quantity, by Rabourdin's process, strongly coloured crystallised sulphate of quinine (per 1000), 29·50; Le Maitre's process, yellow-coloured sulphate, 26·75; my process, colourless sulphate, 31·25. Trials with other kinds of bark yielded similar results, but I should mention that the separation of the quinine as sulphate only succeeds well when the quantity of quinine in the bark greatly exceeds the cinchonine.

To exhibit the effect of an excess of cinchonine I quote the following:—Sulphate of quinine, 0·40; cinchonine, 0·60; acid $\frac{1}{10}$, 10 c.c., yielded—sulphate of quinine, 0·58 (mixed with cinchonine); cinchonine, 0·48: the impure sulphate of quinine thus obtained may be purified, recrystallised, and tested with ether and ammonia.

As sulphate of quinine is completely insoluble in a solution of sulphate of ammonia, there is no fear of any of the sulphate of quinine being left in the mother-liquor if the saturation with ammonia is sufficiently complete. To prove this experimentally, take a small quantity of sulphate of quinine, shake it up in a test-tube three parts filled with cold distilled water, filter, and add to the filtrate a few crystals of sulphate of ammonia. After a few minutes the liquid will become a pasty mass: this is filtered, and not a trace of sulphate of quinine is found in the filtrate.

* *Bulletin de la Societe Chimique de Paris.*

† It is preferable to dry at 100°, and, after having weighed, to add the 12 per cent of water lost by the operation: in that condition it contains 75 per cent quinine.

ON SLOW COMBUSTION.

By P. J. Van KERCKHOFF, Ph.D., &c.,
Professor of Chemistry at the University of Groningen, Netherlands.

A LARGE number of substances possess the property of combining, in a shorter or longer period of time, according to the prevailing conditions, with oxygen, and form therewith oxidised compounds. In many instances this slow or rapid oxidation depends (all other conditions remaining unaltered) upon the temperature, but it is not the only factor. To the large number of conditions which influence oxidation belongs the presence of a substance which is found unaltered after the action is finished; this substance may or may not have undergone any action at all. Many of these actions, formerly known as action of contact, or catalytic action, have become better known by deeper investigation; it has been ascertained that they could be reduced, either to ordinary chemical actions, in which the active substance became alternately metamorphosed and reproduced, or to modifications of physical conditions implying generally a change of temperature. To the alternate fixation and giving off of oxygen belongs, for instance, the action of deutoxide of nitrogen and of ferric oxide; to the second, the remarkable property of platinum, first discovered by Sir Humphrey Davy, to determine chemical combinations in general, and consequently also oxidations, while the platinum itself is not chemically altered. This property of platinum has led to experiments with other substances, many of which were found to act in a manner similar to platinum. The researches of Döbereiner, Pleischl, Dulong, Thénard, Cloez, and others have brought to light a great many facts relating to this subject. As, however, the conditions which play a part in the

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phenomenon alluded to, and the influence of which ought to be known, have not all been thoroughly taken into account, it appeared to me that the study of some of them would not be useless. I have limited my investigation to the action of oxygen upon a couple of combustible gases—viz., (1) on a pure (unmixed) gas, oxide of carbon; and (2) on the mixture of gases constituting ordinary illuminating gas, care having been first taken to completely eliminate all the carbonic acid. The following principal points were investigated :—

(1). What degree of influence is exerted by the time of duration of the contact between the combustible gas and oxygen, in the presence of chemically passive matter.

(2). Whether this duration varies according to the nature of the solid matter.

(3). Whether, for different gas mixtures, the slow combustion requires a different temperature.

(4). Whether the carbonic acid, which must be generated in the case of oxidation, is evolved in the state of gas, or remains condensed in the porous matter.

(5). Lastly, among the solid substances in the presence of which the combustion can proceed, I have chosen one which hitherto has scarcely been investigated, and could be used in pure state without carrying over oxygen to the combustible substance.

My first experiments were so arranged that a mixture of oxygen and combustible gas, each of these being previously freed from any trace of carbonic acid, was slowly passed through a U-shaped tube containing the solid material to the influence of which it was desired to submit the gaseous mixture. The gas, after having passed through the U-shaped tube, was conveyed through clear lime-water. The U-tube could be placed, if required, in a water-bath, so as to keep up any degree of temperature desired. The oxygen, prepared from chlorate of potassa and collected in a gas-holder over pure water, was in every experiment passed through a tube containing soda-lime, in order to eliminate any carbonic acid or chlorine with which it might accidentally be contaminated; then it was passed through a large bottle containing lime-water. The same precautions were taken with the oxide of carbon, prepared by the action of sulphuric acid upon oxalic acid, the gas being thoroughly washed through milk of lime previous to being conveyed to the gas-holder, the tank of which was also filled with thin milk of lime. The ordinary illuminating gas, which nearly always contains traces of carbonic acid, was, of course, purified. In all the experiments, the gas, on being tested previous to its passage through the U-tube, was found to be free from carbonic acid.

The solid substances employed in these experiments are—(1) platinised asbestos previously ignited; (2) pumice stone, first repeatedly boiled in dilute hydrochloric acid, next well washed, and lastly ignited; (3) pipe-clay treated in the same way. Repeated experiments taught that, between temperatures varying from 5° to 15°, platinised asbestos was the only one of the three substances which caused the oxidation of the oxide of carbon. The mixture caused, after having passed the asbestos, in a relatively short time, a precipitate in the bottle containing lime-water; but in the case of pumice-stone and pipe-clay not the slightest turbidity was observed. This result with the platinised asbestos could be readily foreseen, as it is well-known that spongy platinum even causes the deflagration of a mixture of oxide of carbon and oxygen, especially when these two gases are mixed in the proportion of 2 vols. of CO for 1 vol. of O. By the use of platinised asbestos the action is slackened sufficiently by the state of division of the platinum between the fibres, that no explosion of the gases takes place. When a mixture of 1 vol. of illuminating gas and 2 vols. of oxygen were caused to pass, at a temperature of from 5° to 15°, through the U-tube filled with platinised asbestos, not a trace of carbonic acid was formed. Similar experiments were made with pumice-stone and pipe-clay, first at a temperature of from 50° to 60°, next at between 80° and 90°, but in neither of these operations was any carbonic acid formed. As an instance of the mode of operating and experimenting, I quote the following description of an experiment :—

Coal-gas and oxygen, both quite free from carbonic acid, were mixed in the proportion of 1 vol. of the first and 2 vols. of the second, and passed through a U-shaped tube of about 10 c.c. capacity, filled with 5 grms. of purified pipe-clay; the tube was placed in a water-bath kept at a temperature of from 50° to 60°. The velocity of the current of the gas was so regulated that the outlet-tube, having an internal diameter of 5 m.m., passed four bubbles of gas per second, while the operation was kept going on for half an hour; neither during this time, nor after it, was the slightest turbidity caused in the lime-water, through which the gas was passed when leaving the outlet-tube.

Judging from the results of experiments to be presently mentioned in detail, it might be suspected that a small quantity of carbonic acid, which might have been formed at the temperature alluded to, could have been retained in the U-shaped tube by the pipe-clay. In order to ascertain this, the gaseous mixture retained in the tube was first expelled by a current of air previously freed from carbonic acid at the ordinary temperature, and the tube next heated up to nearly 100°, while the current of air was kept up. Even after this operation the lime-water remained perfectly clear.

In the second series of experiments, made with the same mixture of combustible gas and oxygen, the duration of the contact with the solid substance has been much prolonged, and consequently the arrangement of the apparatus was different. The gases intended to be experimented with were mixed and measured in the proportion of 2 vols. of CO and 1 vol. of O, or of 1 vol. of coal-gas and 2 vols. of O, in a glass bell-jar fitted with a stop-cock, and placed over lime-water; by forcing the bell-jar down into this fluid the gas could be forced out of it. This gas mixture was next made to pass through a tube filled with soda-lime, and next through a bottle containing lime-water, which, in order to make the experiment reliable, ought to remain quite clear, and this was so in all the experiments recorded. A glass vessel of about 600 c.c. capacity, and fitted with two necks, is filled with the gas mixture, care being taken to cause the gas to pass for some time slowly through the vessel for the purpose of eliminating the air it contains. Into each of the necks is tightly fitted a cork, which is varnished, and into each of which a short glass tube is fitted tight; a stout vulcanised india-rubber tube is tied to each of them. By means of a spring-clip these tubes can be closed if desired.

The balloon-shaped glass vessel, into which some 5 to 6 grms. of the solid substance (after being ignited) to be experimented with has previously been placed, having been well filled with gas, and the inlet- and outlet-tubes closed, could be kept at the desired temperature without any chance of atmospheric air being introduced into it, as proved by the negative results of several of the undermentioned experiments. To ascertain, at the end of the experiment, whether oxidation had or had not taken place, the contents of the balloon were tested as follows :—One of the caoutchouc tubes fastened to the neck of the balloon was connected with a test-bottle filled with lime-water, to which was further connected a tube filled with soda-lime, through which the atmospheric air, intended for the purpose of displacing the gas contained in the balloon, had to pass. To the other caoutchouc tube was fastened a glass tube, destined to carry off the gas from the balloon into lime-water, contained in a double-necked bottle and connected with an aspirator. In this manner, it was possible to regulate at will the rapidity of the current of the air from the balloon into the lime-water. Although there could be no doubt that platinised asbestos would, in this mode of experimenting, just as in that above referred to, cause oxidation, we have again tried it, and pumice-stone and pipe-clay have also been used. Each of the following experiments has been repeated, always with the same results :—

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Experiments made with Oxide of Carbon.

Temperature, 0° to 10°. Duration of experiment, 16 days.

Lime-water.

Platinised asbestos — Yields a turbidity after the passing of a few bubbles of gas, and afterwards an abundant precipitate.

Pumice-stone .. — Remains quite clear.

Pipe-clay .. .. — Remains quite clear.

Temperature, 5° to 15°. Duration of experiment, 16 days.

Lime-water.

By passing the gas of the balloon into it without application of heat—	By passing air into the balloon after the gas has been eliminated, the solid substance being simultaneously heated—
Pumice-stone { Remains quite clear. }	Remains quite clear.
Pipe-clay..Remains quite clear.	Remains quite clear.

Temperature, 50° to 60°. Duration of experiment, 9 hours.

Lime-water.

The gas being passed into it without the contents of the balloon having been heated to a higher degree.

Pumice-stone .. Soon gives a precipitate, which in a short time becomes considerable.

Pipe-clay .. .. Remains quite clear.

Temperature, 64° to 65°. Duration of experiment, 16 hours.

Lime-water.

By passing the gas from the balloon into it without further heating the contents—	By passing air through the balloon after the gas has been withdrawn from it, and simultaneously heating of the solid substance—
Pipe-clay { Remains perfectly clear.	Causes soon a turbidity, which increases after a short time.

Temperature, 80° to 90°. Duration of experiment, 12 hours.

Lime-water.

By passing the gas from the balloon into it without further heating the contents—	By passing air through the balloon after the gas has been withdrawn from it, and simultaneously heating the solid substance—
Pipe-clay { Remains perfectly clear.	Becomes rapidly and rather strongly turbid.

Experiments with Coal-Gas.

Temperature, 5° to 15°. Duration of experiment, 9 days.

Lime-water.

By passing the gas from the balloon into it without further heating of the contents—

Pumice-stone .. Remains clear.

Pipe-clay .. .. Causes a perceptible turbidity.

Temperature, 80° to 90°. Duration of experiment, 11½ hours.

Lime-water.

By passing the contents of the balloon into it without further heating the contents—	By passing air through the balloon after the gas has been withdrawn from it, and simultaneously heating the solid substance—
Pumice-stone— Causes a perceptible turbidity.	Becomes strongly turbid and gives a precipitate.
Pipe-clay— Becomes immediately turbid and gives a precipitate.	Not examined.

As regards the experiments with platinised asbestos, I have only to observe that, under its influence, which becomes apparent at the ordinary temperature, coal-gas is burnt less easily than oxide of carbon by oxygen; and it appears that, in the first place, the small quantity of oxide of carbon, contained to an amount of from 7 to 9 per cent in coal-gas, is first oxidised. Leaving out of the question the action of the platinised asbestos, the following conclusions can be drawn:—

(1). That at the ordinary temperature a pumice-stone and pipe-clay cannot, when the time of action is short, cause the oxidation of oxide of carbon, nor of coal-gas when mixed with pure oxygen.

(2). That a contact of brief duration does not produce any perceptible oxidation at temperatures of from 50° to 60°, and even at from 80° to 90°.

(3). That, while the combustion of these two gases is not perceptible when the experiment lasts only a short time, it becomes very perceptible when the experiment is continued for some length of time; it is, therefore, not improbable that, when the experiments were continued for a long time, oxidation would be ascertained to take place where during sixteen days no formation of carbonic acid occurred.

(4). That oxidation or combustion, resulting in the formation of carbonic acid, requires the longer time when the temperature is low.

(5). That there exists a difference between the temperatures at which pumice-stone and pipe-clay begin to exert an influence upon the oxidation of oxide of carbon, pumice-stone becoming active earlier than pipe-clay when the temperature increases.

(6). That, as regards coal-gas, an inverse relation is observed, because pipe-clay already manifests activity at a temperature at which pumice-stone, left in contact with the gas mixture for the same time, does not give rise to oxidation.

(7). That the carbonic acid gas which is formed does not always make its appearance at once as a gas in free state, but may remain entirely occluded in the pores of the solid substance when the quantity of gas operated with is small.

(8). That pipe-clay retains the carbonic acid gas which is formed far more readily than pumice-stone, while the former also only gives it off at a higher temperature.—*Archives Neerlandaises des Sciences Exactes et Naturelles.*

NOTE ON CHLORAL.

By EDWARD R. SQUIBB, M.D.

CHLORAL supplies another forcible illustration of the baneful effects of speculation and inflation, and of the dangers which must always attend popularity, and particularly the popularity of potent medicinal agents. It seems hard to teach the public that nothing can be potent only for good. That to be potent for good involves, in the very nature of all things, an equal potency for harm. Hence the danger of advertising any medical substances which have any potency for popular use. The multitude of mere placebos, and catch-penny quackeries, which serve at the same time to make money and give mental occupation and relief to trifling or imaginary ills, may be puffed and inflated for popular use with comparative safety. But when this same process is applied to a potent agent like chloral, the chances are always greatly in favour of the substance doing more harm than good, until a panic and a prejudice are produced against it, when it may be unjustly condemned and lost.

The definite results from the careful and proper use of chloral, and its great importance in filling a place in therapeutics hitherto vacant, fortunately secure it against being lost by this reaction; and it is perhaps well, therefore, that by the sacrifice of a few lives at the outset of its career, many lives may be saved, and its use be

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restricted to the hands of physicians. Pharmacists cannot be too careful how they advise or dispense such agents for popular use, and they will undoubtedly be, sooner or later, held responsible for all the misuse to which their commodities may be applied.

The experience and education obtained in the making of some 1500 lbs. of chloral within the past year have served to improve the writer's knowledge of this important substance, and may justify him in offering some remarks upon its characteristics and tests.

Since it has become easier to make the hydrate than the alcoholate of chloral, the latter, and all mixtures of it, have practically disappeared from the market without any probability of their ever re-appearing. This renders the tests for alcohol and alcoholates unnecessary.

When the water of hydration is in excess, or when solid compounds of hydrate of chloral and water are put up, the substance is deliquescent, or even melts in warm weather, and a very slight excess of water manifests itself very soon by some degree of deliquescence. Whether in cake or crystal, it is now very generally put up slightly deficient in water of hydration; that is, the chloral is not fully saturated to the condition of a full hydrate, and under proper control this is the best practice yet arrived at by the writer. If it could be exactly saturated, that of course would be best; but, as this seems not easily practicable it is best to have the water a little short of full hydration. If more than a shade short, however, the hydrate is proportionally pungent, because anhydrous chloral is much more pungent than the hydrate. Another disadvantage of the presence of free or anhydrous chloral is, that it renders the hydrate which contains it more liable to become slightly acid. These circumstances, and the fact that under varying conditions chloroform dissolves more or less water, and watery solutions dissolve more or less chloroform, together render the chloroform test fallacious and comparatively useless as ordinarily applied. That is, the yield of chloroform may be always the same if the decomposition be complete, but it cannot be weighed or measured with sufficient accuracy.

Chloral has now been made in such quantities, and with so much competition, and it is so comparatively easy to make it of fair quality, that the mistakes and imperfections arising from ignorance are now no longer made, and the general quality has got far beyond the reach of the earlier tests. More sensitive and more delicate tests are now needed—not to decide whether a given substance is hydrate of chloral, but to decide between different specimens of hydrate of chloral which come into the markets, even from the same manufacturer—as to which contains the least or the most of other and mere accidental products of the action of chlorine on alcohol. In all the better brands these accidental products are in very small proportion, and not easy of detection. Just as in the instance of chloroform, they are neither made nor left in it purposely or carelessly, and the defect lies simply in the insufficiency of the means and the labour necessary to take the last portions out. Within practical limits they may all he taken out by any of the processes in use for the purpose, provided these be used with sufficient skill, pains, and labour; and the want of uniformity of the best brands now in the market is chiefly due to want of care and labour. That is, profit being the chief object, this is increased by dodging its greatest enemy, namely, skilful labour.

After a large number of examinations, the writer comes to the conclusion that at present there is no single test which will indicate the quality of chloral, and that the value of any group of tests depends almost entirely upon the skill and care with which they are applied. The sensible properties are very characteristic to those who are expert and familiar with the substance, and by a little education and practice any one may soon attain a pretty critical judgment.

The writer still greatly prefers the granular crystalline *form to any other, as* conducive to greater purity, and the most simple and critical mode of examination known to the writer, and which has not been hitherto published, is by means of chloroform. Chloral and its hydrate are both freely soluble in chloroform, and from this solution, when dropped on bibulous paper or evaporated from a watch-glass, the chloroform flies off first, the anhydrous chloral next, and the hydrate last and more slowly. The impurities are still less volatile, and may be detected in the later stages of the evaporation by their different odour. The hydrate of chloral, after the last traces of anhydrous chloral have passed off, is comparatively inodorous, and what odour it has is very mild, sweet, and clean, so that any contamination of this mildness and sweetness is the more easily recognised. The chloroform used must of course be itself free from much impurity, and should not colour sulphuric acid. The solution of chloral in chloroform, when tested with sulphuric acid, just as chloroform is tested, should give no colour to the acid. The acid should be poured slowly into the chloroform solution, when the slightest change of colour can be seen at the line of separation between the two liquids before they are shaken together. Indeed, after shaking, the coloured stratum becomes so diluted by the excess of acid, that the tint may be hardly recognisable. So delicate is this test that, when carefully and properly managed, no specimen of chloral has ever been seen, except when taken directly from the purifying flasks, that would not give *some* colour at the line of separation between the liquids. That is, the atmospheric dust, which is unavoidable in the handling and putting up of the chloral, is sufficient to give a tinge at the line of separation. As in the case of chloroform alone, the colour, however much or little, increases by standing, and is only fully developed after twenty-four hours. In this testing the chloroform alone should be tested, side by side with the chloroformic solution of chloral, and only the difference be taken into account. Of course colourless concentrated sulphuric acid should be used, and a chemically clean glass-stoppered bottle, as in the testing of chloroform.

The next important step in the examination, not hitherto published, is the freezing-point, or the temperature at which the chloral begins to crystallise when melted. This point appears to be very definite, and is very easily ascertained. An ounce bottle of chloral, as purchased, should have the glass stopper loosened, but not removed (it should never be sold in any other than glass-stoppered bottles), and the bottle should be then immersed to the shoulder in warm, not hot, water, and occasionally shaken until the chloral is melted. The liquid chloral should, of course, be colourless, transparent, and free from specks of foreign matter to a practical degree. The bottle should then be taken from the warm bath, the stopper removed, and, while held by the neck, the bulb of a small chemical thermometer should be placed in the liquid and used continuously as a stirrer until the liquid becomes opalescent or loses its bright transparency. At this moment the temperature should be taken and noted. The bottle is then again placed in the warm water, and the contents stirred until again transparent; then again removed from the bath and again stirred to the crystallising point, and the temperature again noted for verification of the first trial. This does not waste nor injure the chloral at all, and the thermometer, when removed, should be immersed in distilled water in a small test-tube, to dissolve off the adherent chloral. The solution thus obtained, if tested with pale blue litmus-paper, will commonly indicate slight acidity, and with solution of nitrate of silver will give slightly more cloudiness than the water alone will give. The writer has never tested a specimen of chloral which had been six months made, which did not give evidence of slight hydrochloric acid acidity, if the testing was delicate. Hence it is not amiss, though perhaps not important, to add a drop or two of ammonia to all solutions of chloral when dispensed for use, as originally advised by Liebreich, since it may serve to arrest a commencing decomposition which might soon become rapi

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solution, particularly when the solution is to be kept many days, or when it has organic matter of any kind in it.

To return to the freezing-point. Specimens of chloral from the best makers may be found in the market, which begin to crystallise at from 45° C. = 113° F., up to 52° C. = 125·6° F. The best specimens, however, crystallise between 48° C. = 118·4° F., and 51° C. = 123·8° F. Those which crystallise at the higher temperatures contain the most anhydrous chloral, and those which crystallise at the lower temperatures contain an excess of water. Accurately hydrated chloral crystallises at about 48° to 49° C. = 118·4° to 120·2° F., and the best practically adjusted specimens crystallise within one-half a degree of 50° C. = 122° F. Specimens which crystallise below 48° C. = 118·4° F. do not stand summer temperatures without becoming moist, whilst those which crystallise below 47° C. = 116·6° F., are proportionately deliquescent. This tendency to deliquesce is, however, mainly due to the interstitial mother-liquid, and this liquid it is which absorbs the moisture of the atmosphere, and thus finally dissolves the crystals in warm weather. Hence, as large crystals can only be obtained by comparative slow crystallisation from more dilute solutions, they contain the most watery liquid in the interstices, and therefore soonest deliquesce. A basin of large crystals, looking somewhat like bromide of potassium, in regard to the size of crystal, stood upon the writer's table covered loosely with paper, from March until September. Up to the 1st of June they remained quite dry, and could be powdered as easily as bromide of potassium. They then began to grow moist, slowly at first, but very rapidly during the latter part of July, and now in September there is a confused mass of crystals at the bottom of the capsule, covered by an inch or more of transparent syrupy liquid.

A few pounds of these same crystals standing in the same place, in an imperfectly stoppered, wide-mouthed bottle, and this frequently opened, have kept much better, and are in fair condition, though moist. Small granular crystals, which form from the melted chloral when carefully underhydrated, seem to be by far the best form for convenient practical use.

All the writer's experiments, and they have been numerous, of crystallising from bisulphide of carbon, from ether, from chloroform, and from oil of turpentine, have failed in practicability.

Another important test of quality for commercial chloral is its boiling-point. This was early recognised as a test, because no two liquids are known which boil at precisely the same temperature, while all mixtures are known to have a moving boiling-point, that is, do not boil continuously at any fixed temperature. Writers, however, have given a very different value and significance to this test, some regarding it as no test at all, while others have considered it infallible. This discrepancy appears to depend upon the skill or want of skill and knowledge with which the test was applied. Most liquids can be heated far above their boiling-point without boiling, but all can be made to boil at the normal boiling-point by proper management. Chloral simply heated in a clean test-tube may, or may not, boil at its boiling-point. But if the test-tube be one-sixteenth filled with broken glass, and be heated in a glycerine bath, the chloral will boil at its normal boiling-point, and will continue to do so, and a chemical thermometer immersed in it will indicate the boiling-point with accuracy.

Accurately hydrated chloral begins to give off bubbles of vapour from the hottest surfaces of the tube when the thermometer indicates about 90° C. = 194° F., but it does not properly boil throughout the liquid below 97° C. = 206·6° F., and one-half of it at least will boil off before the temperature varies much from this point. It however appears to gradually decompose from air contact, or some other cause, underhydrated chloral boiling off, and overhydrated chloral remaining, so that the boiling-point gradually rises after boiling for some time. The best commercial specimens of chloral—that is, a little underhydrated—begin to boil throughout the liquid at about 96·5° C. = 205·7° F. The underhydrated portion, however, boils off in a few seconds, and the thermometer rises to 97° C. = 206·6° F., and finally to 97·5 or 98° C. = 207·5° or 208·4° F., by the time that half the liquid has boiled off.

Chloral should not begin to boil fairly below 95° C. = 203° F., because if it does it is too much underhydrated, and therefore too liable to decomposition; and it should boil down to one-half steadily at 97° to 98° C. = 206·6° to 208·4° F. If it boils off above 98° C. = 208·4° F., the indication is that it is overhydrated and deliquescent.

The natural accidental impurities which are left in the chloral are, in all the better grades, in so small a proportion as to escape detection by any ordinary application of the boiling-point test.

In conclusion, it may be remarked that, while several of the grades of chloral now to be found in the market are worthy of confidence, they are by no means uniform, but are improving in this respect; and there is no reason to fear that good chloral will ever again be accessible at a moderate price. The enormous scale upon which it has been made in Germany, and the difficulty of reducing this scale to meet the reaction which fatal cases of poisoning in popular use has caused, have overstocked and very much depressed the market; and it is to be feared that some of this overstock may become decomposed before it can be consumed. The quality should therefore be closely watched, and as soon as a parcel is found to be strongly acid it should be rejected. The test of acidity by means of a glass rod wet with solution of ammonia held near the mouth of the bottle, though useful, is not entirely trustworthy, and is hypercritical, since the vapour of anhydrous chloral, whether of itself or by slight decomposition from air contact, produces a cloud with ammonia.

ON THE

STYLE OF GAS-BURNER FOR BENDING GLASS TUBES.

By H. CARRINGTON BOLTON.

PROFESSOR J. LAWRENCE SMITH, in a note "On Bending Glass Tubes for Fitting Apparatus" (CHEMICAL NEWS, vol. xxv., p. 175), recommends a Bunsen burner flattened at its extremity so as to give a thin broad flame. This is certainly a great improvement on the commonly employed burner, but an ordinary fish-tail or bat-wing gas-burner will be found to give, if possible, still better results. The writer has employed for some years an ordinary bat-wing burner attached to a small, short stand (3 inches high, burner included), so as to rest low upon the table, in order that raising the arms inconveniently high may be avoided. Such a burner insures a broad flame, by which the tube is heated for two or more inches in length; the tube is turned while in the flame, and removed for bending as usual.

The deposit of carbon, which, at first sight, might seem an objection, is really one of the chief advantages of using this burner. On placing the glass in the flame, the deposit begins immediately and prevents too rapid a rise of temperature and consequent cracking of the glass; during the heating the carbon tends to distribute the heat equally over the surface of the tube; and, finally, on withdrawing the glass from the flame too sudden cooling is prevented, and the glass is, as it were, annealed.

The black deposit is readily removed by a dry cloth. This plan was commonly employed in Hofmann's laboratory, Berlin. In bending tubes of more than three-eighths of an inch in diameter, one end should be closed tightly with a cork (or wax) and air blown into the other end a-

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the moment of bending the tube; by regulating judiciously the pressure of the air upon the sides of the somewhat softened tube, the latter will neither bulge out nor collapse, but will retain its proper calibre. This cannot be effected, however, with very large tubes, or with very thin ones, which require the nice manipulation of the professional glass-blower.—*American Chemist.*

ON THE ECLIPSE EXPEDITION, 1871.*

By J. NORMAN LOCKYER, F.R.S., M.R.I.

I UNDERSTAND my duty to-night to be to give an account of the observations made, not by all who observed the eclipse of last December, but by the members of the party which went out under the auspices of the British Association, and it is extremely fortunate that nothing more is required of me—first, because most valuable work was done by the other parties, which of itself would require more time to state than I have at my disposal; and secondly, because the amount of material obtained by the members who were sent out from England, and by the friends who met them at every point, is so great, that it would be impossible in one discourse to give anything like an exhaustive account of it. Here are some of the records in this portfolio. You will see at once that even for one party I can only make a selection, and I am perfectly aware of the extreme responsibility which attaches to anyone who may venture to make a selection out of such an enormous mass of material as we have collected.

Before I proceed to discuss the work done by the different parties, it will be desirable to give an idea of the arrangements, and for this purpose I have prepared several maps, which will enable you to see what the British Association parties did.

In the first instance, I may remark that the weather conditions were somewhat problematical. Another point of great importance was that much of the ground was fortunately occupied, and it was essential, when placing the parties, to bear these two considerations in mind—the possibility of bad weather; and then the importance of so arranging matters that, if some of the observers were clouded out belonging to our parties, then the story might be continued by other observers.

Here we have a map of India, which gives you a general idea of the path of the shadow during the eclipse. The shadow, you see, strikes India on the western coast, and it runs down in a south-westerly direction and cuts the northern portion of Ceylon.

When we arrived in India we found that the Indian observers, consisting of those well-known men, Tennant, Herschel, Hennessy, Pogson, and others, had determined, from their knowledge of the climatic conditions of India at that time of the year, to occupy the central part of the line, and also a station at a low level; the eminent French physicist, M. Janssen, taking up his position at the top of the Nielgherries. We were to station ourselves either east or west, or both, of these parties. Whether east or west would depend upon the monsoon, and the great question that was being discussed on our arrival was, Was the monsoon favourable?

I have not time to go into the many interesting points touching the answer to this question; but I may say shortly that what we heard was, that if the weather was likely to be bad on the east side of the hill range, generally called the Ghauts, there was a good chance for anyone occupying a position west of those hills. What happened was that we did occupy the positions marked by blue wafers on the map, viz., Bekul on the west coast, Manantoddy on the western slope of the Ghauts, Poodocottah in the eastern plain, and in the Island of Ceylon—first, Jaffna, and secondly, Trincomalee.

Such were our arrangements. The parties were stationed along the line of totality. Very different were the arrangements of the Sicilian party of the former year. In Sicily we were compelled to throw ourselves *across* the line of totality in the direction which I have indicated on this map of Sicily.

Now what was the work we had to do? If you will allow me to refer to two or three results of the former eclipse Expedition, I will endeavour to put them before you without taking up too much of your time.

One of the most important among the results obtained in the eclipse of 1870 was this:—Far above the hydrogen which we can see every day without an eclipse—far above the prominences, the spectrum of hydrogen had without doubt been observed by two or three of the American observers, who were more fortunate than we were. Among them, Professor Young stated that the spectrum of hydrogen was observed to a distance of 8 minutes from the sun; he then adds, "far above any possible hydrogen atmosphere." This is point number one.

Another of the points was this: the unknown substance which gives us a line coincident, according to Young, with a line numbered 1474 by Kirchhoff, has been observed by the American observers to a height of 20 minutes above the limb of the dark moon.

Now, it was a very obvious consideration that, if we got a spectrum of hydrogen 8 minutes from the dark moon, when we thought we knew that the hydrogen at the sun did not really extend more than 10 seconds beyond the dark moon, there was something at work which had the effect of making it appear very much more extensive than it really was; and it was fair to assume that, if this happened in the case of the hydrogen, it might also happen in the case of the unknown stuff which gives us the line 1474.

In support of this view we had one of the few observations which were made in Sicily, in the shape of a drawing of the corona, as seen by Professor Watson, who observed at Carlentini. He saw the corona magnificently; and being furnished with a powerful telescope, he made a most elaborate drawing of it, a rough copy of which I will throw on the screen. You will see at once that we had in this drawing something which seemed to militate against the idea that the 1474 stuff at the sun did exist to a height of 20 minutes. According to Professor Watson, the boundary of the real corona was clearly defined, its height being far under that stated.

Next, we had another observation of most important bearing on our knowledge of the base of the corona. I refer to the announcement of the observation by Professor Young of a stratum in which all the Fraünhofer lines were reversed. It was asserted that there was undoubtedly a region some 2 seconds high all round the sun, which reversed for us all the lines which are visible in the solar spectrum. We had, in fact, in a region close to the photosphere, the atmosphere of the sun demanded by Kirchhoff at some distance above the photosphere.

Last, not least, we had the photographic evidence. There was in Sicily a photographic station at Syracuse, and the Americans had another in Spain. I now show on the screen a drawing—it is not the photograph itself, but a drawing of a photograph made by the party in Sicily; what we have on this photograph is a bright region round the dark moon, which is undoubtedly solar, but stretching out right away from this, here and there, are large masses of faint light with dark spaces between them, which have been called rifts. Now the question is, Is this outer portion solar?

Having thus brought rapidly before you some of the questions which we had principally to bear in mind, and, if possible, settle (though that is too much to hope for in any one Eclipse Expedition) in the work we had to do in India, I will next bring to your notice some new

* A Lecture delivered before the Royal Institution of Great Britain. The chief results obtained by the expedition have been taken from the *ad interim* Report presented to the British Association Meeting at Brighton. The lecture itself dealt mainly with the methods and instruments employed.—J. N. L.

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of inquiry which had been proposed with the object of extending former observations.

I may here remark that the Royal Astronomical Society, in the first instance, invited me to take charge of an expedition to India merely to conduct spectroscopic observations; but, although this request did me infinite honour, I declined it, because the spectroscope alone, as it had been used before, was, in my opinion, not competent to deal with all the questions then under discussion. I have told you that some of the most eminent American observers had come to the conclusion that the spectrum of hydrogen observed in the last eclipse round the sun, to a height of 8 minutes, was a spectrum of hydrogen "far above any possible hydrogen" at the sun. Hence it was in some way reflected. Now, with our ordinary spectroscopic methods, it was extremely difficult, and one might say impossible, to determine whether the light which the spectroscope analysed was really reflected or not; and that was the whole question.

It became necessary, therefore, in order to give any approach to hopefulness, to proceed in a somewhat different way in the 1871 expedition, and, in order to guard against failure, to supplement such new observations by photographs; and fortunately we were not long in coming to a conclusion that this might be done with some considerable chance of success.

I have here a train of prisms. I will for one moment take one prism out of the train, and we will consider what will happen if we illuminate the slit of the lantern with a monochromatic light, and observe it through the prism. If we render sodium vapour incandescent, we know we get a bright yellow image of the slit, due to the vapour of the metallic sodium only giving us yellow light. But why is it that we get a line? Because we always employ a line for the slit. But suppose we vary the enquiry. If, instead of a straight line, we have a crooked line for the slit, then we ought to see a crooked line through the prism. Now allow me to go one step further. Suppose that, instead of a line, whether straight or crooked, we have a slit in the shape of a ring, shall we see a ring through the prism? You will see that we shall. And then comes this question: If, when we work in the laboratory, we examine these various slits, illuminated by these various vapours, why should it not happen that, if we observe the corona in the same way, we shall also get a ring built up by each ray of light which the corona gives to us; since we know, from the American observations, that there were bright lines in the spectrum of the corona, as observed by a line slit? In other words, the corona examined by means of a long train of prisms should give us an image of itself painted by each ray which the corona is competent to radiate towards us.

Now let us pass to the screen, the screen merely replacing the retina. We will first begin with the straight slit, with which you are familiar—we now have our slit fairly focussed on the screen—we then in the path of the beam interpose one of these prisms, and there we get on the screep a bright line.

Now, to continue the argument, we replace the straight slit by a crooked one, and you see we get a crooked image on the screen. We now replace this crooked slit by a ring. We have now a ring-formed image on the screen. So that you see we can use any kind of narrow aperture we choose, and as long as we are dealing with light which is monochromatic, or nearly so, we get an image of the aperture on the screen.

If we consider the matter further, it will be evident that we may employ a mixture of vapours, and extend this result.

We will now, for instance, instead of employing sodium vapour, employ a mixture of various vapours. You see now that each ray given by these substances, instead of building up a line image, is building up for us a ring image —that we have now red, green, yellow, blue, and violet rings.

Now that was the consideration which led to the adoption of one of the new attempts to investigate the nature of the corona used this time. It was, to use a train of prisms, pure and simple, using the corona as the slit, a large number of prisms being necessary to separate the various rings we hoped to see, by reason of their strong dispersion. On the screen the rings to a certain extent intersect each other; and it would have been easier to show you the ring-form of the images if we could have used more prisms than one.

If this is good for a train of prisms such as I have referred to, it is good for a single prism in front of the object-glass of a telescope. Such was the method adopted by Prof. Respighi, the distinguished Director of the Observatory of the Capitol of Rome, who accompanied the expedition.

Now you may ask, How would this method, if it succeeded, be superior to the ordinary one. In this way. If we were dealing merely with reflexion, then all the rings formed by vapours of equal brilliancy at the base of the chromosphere would be of the same height, while if reflexion were not at work the rings would vary according to the actual height of the vapours in the sun's atmosphere, and the question would be still further advanced if the spectrum did not contain a ring representing the substance which underlies the hydrogen.

Our *new* spectroscopic equipment, then, was as follows:—

1. A train of five prisms.
2. A large prism of small angle placed before the object-glass of a telescope.
3. Integrating spectroscopes *driven by clockwork*.
4. A self-registering integrating spectroscope, furnished with telescopes and collimators of large aperture, and large prisms. (This instrument was lent by Lord Lindsay.)

Now a word about the polariscopic instruments, referring you to my lecture given last year for a general notion of the basis of this class of observation.

A new idea was, that observations to determine the polarisation of the corona might be made with the same telescope and eye, both with the Biquartz and the Savart.

By the kindness of Mr. Spottiswoode, who has placed his magnificent polarising apparatus at our service, I hope to be able to show you on the screen the mode of examining the corona by means of those two instruments, so as to enable you pretty well to follow what was actually done.

Let me begin with the Biquartz polariscope. In the first instance I will throw on the screen a representation of the corona itself, and we will then insert a Biquartz, and see its effect when I flood the screen with polarised light. You now see an indication of what would be observed supposing the polarisation was due to polarised light diffused in the region between us and the dark moon and eclipsed sun, in which case the polariscopic effect would be observed generally over the dark moon, the corona, and the region of the sky outside the corona. But this is not all; not only does this arrangement enable us to determine the existence of such a general polarisation, but the vertical line in the Biquartz called the line of junction indicates the plane of polarisation, when the colours on both sides of it are the same; so that we have two colours strongly contrasted in either half of the field when we are away from the plane of polarisation, and a uniform colouring of the whole field when in or at right angles to that plane. By turning this prism through 90 degrees, you see I entirely change the colours.

But we are not limited to the Biquartz in this inquiry. We can apply the Savart polariscope. Having still our image of the corona on the screen, I now replace the Biquartz by a Savart.

We now no longer see a line of junction with the similar or different colours on either side of it, but lines of colour running across the image. I turn the prism. We first see the lines with a white centre, then with a dark one, while at times they are altogether absent. And as a departure from the plane, when we use the Biquartz, gives us the strongest contrasts of colour, so you observe that

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with the Savart under these circumstances all indications of polarisation vanish.

Now, if we assume polarisation to be general, and the plane of polarisation vertical, we should get those coloured bands, as you see them there, crossing the corona and dark moon, the lines being vertical and dark-centred. If the plane of polarisation were horizontal, we should find the lines horizontal and the central one white.

But so far as we have gone we have been dealing with polarisation which is general, and we have not attempted to localise polarisation at the corona itself. But I have here an apparatus, by means of which, quietly, in this theatre, one can see as admirable an example as we should desire of polarisation, assumed to be particular to the sun and not general—I mean radial polarisation. We have simply a circular piece of mahogany, or something else which polarises light equally well, with a hole in the middle with sloping sides, cut as you see this cut, and then we place behind it a candle, so that the light of this candle, after falling on oiled tissue paper stretched across the aperture, can be reflected to the eye by the sides, the direct light of the candle being stopped by a central metallic diaphragm. We have now a source of polarised light of a different kind from the last. The next thing we have to do is to introduce into a small telescope exactly the same kind of apparatus we have there, though of course on a much smaller scale, and examine the ring of light seen when we put the candle behind the aperture. On examining the ring of light which is now visible by means of this telescope, which contains a Biquartz and analyser, I see the most exquisite gradations of colour on either side the line of junction which cuts the field of view and the bright ring in the centre into two.

Now, instead of the candle, we will employ the electric lamp; and instead of the eye, the screen; but I must inform you that the great heat of the electric lamp prevents the appearance being perfectly successful on the screen, as the reflecting varnish is melted.

In this experiment we cannot work with an image of the corona. We must make our corona out of the image of the ring we hope to get on the screen, and then, by employing the Biquartz in the same way as before, instead of getting similar colours on either side of the line of junction, as we did when we were working in the plane of polarisation, and getting the greatest contrasts, as we did when we worked 45 degrees away, you observe we get different colours in each part of the ring.

On the screen we now have a highly-magnified image of the hollow cone of iron which I am compelling to reflect the light from the lamp; and by inserting this Biquartz I throw various colours over different portions of that ring, which I beg you to consider for one moment as the solar corona, and the colours change as I rotate this prism. You will at once be able to explain the different actions of this Biquartz in this instance. The reflexion, and therefore the plane of polarisation, is no longer general, but varies from point to point of the reflecting surface. It is in fact radial, and hence the delicate radiate arrangement of colour.

Such, then, were some of the new methods and new instruments we used, for the first time, in our researches.

(To be continued.)

NOTICES OF BOOKS.

Investigation of some of the Ammoniacal Waters of Gas-Works, and on the Presence of Chlorine Compounds in Coals. By Dr. G. Th. Gerlach.

This essay contains in detail the method of analysis and the results of the author's researches on several kinds of ammoniacal liquor, as obtained from various kinds of coal at some of the German gas-works. As instances, we quote the following:—100 c.c. of the ammoniacal liquor of the Chemnitz (Saxony) gas-works, where Zwickau coal is used, contain, in grms.—Hyposulphite of ammonia, 0·1036; sulphuret of ammonium, 0·0340; bicarbonate of ammonia, 0·1050; carbonate of ammonia, 0·4560; sulphate of ammonia, 0·0462; sal-ammoniac, 3·0495. Gas-water from the Bonn gas-works, where Ruhr coals are used, contains, in 100 c.c., in grms.—Hyposulphite of ammonia, 0·5032; sulphuret of ammonium, 0·6222; bicarbonate of ammonia, 0·245; carbonate of ammonia, 3·3120; sulphate of ammonia, 0·1320; chloride of ammonium, 0·3745. The author calls special attention to the fact that the presence of chlorine compounds in coals has been hitherto overlooked, because these compounds are volatilised in the shape of chloride of ammonium when the coal is incinerated. The quantity of chloride of sodium in the Zwickau coal amounts to about 3 per mille, and, since it contains about 2 per cent of ash, that ash should contain about 15 per cent of chloride of sodium.

Das Anthracen und Seine Derivate. Für Tecknik und Wissenschaft nach der bis jetz bekannten Quellen Zusammengestellt. Von G. Auerbach, Assistent am Eidgenossischen Polytechnicum zu Zürich. Berlin: O. Seehagen. 1873.

This work is scientifically and industrially of great value. We quote the headings of the leading chapters:—Introduction, containing historico-scientific review of the discovery of anthracen in 1832 by Dumas and Laurent, who called it paranaphthalin, and a *resumé* of the researches of a large number of *savants* up to the present day; constitution of anthracen and its derivatives; preparation and properties of anthracen; hydrides of anthracen; bromine derivatives of anthracen; chlorine and anthracen; nitro- and sulpho-compounds of anthracen; azo combinations of anthrachinon; other combinations of anthrachinon; alizarine (this chapter contains valuable information on the researches on madder, its preparations, its colouring principles, and its chemical combinations); chrysophanic acid; chrysamminic acid; franguline; frangulinic acid; an appendix, containing practical receipts for dyeing with native and artificially-prepared alizarine. The author is to be congratulated for the clear and excellent manner in which he has treated his subject. In addition to a general index, we notice a plan which might be more generally adopted, under the title of "Autoren register," an alphabetically-arranged index; for instance, under Alizarine we find a complete list of, not only the names of authors, but the periodicals in which their essays are published. The numerous and complex formulæ are prominently set forth.

CORRESPONDENCE.

SANITARY ARRANGEMENTS OF THE METROPOLIS.

To the Editor of the Chemical News.

Sir,—I beg most respectfully to submit the following for the favour of your consideration; my apology for doing so being that it is a sanitary question of considerable importance, not merely to the inhabitants here in particular, but to the public generally. Our Medical Officer of Health states that there are 100 fish-smoking houses in this parish. One of these is in the heart of a densely populated neighbourhood. In it are cured—according to the report of our own Medical Officer of Health—every night, including Sundays, between 40,000 and 50,000 herrings. Fourteen fires, made from the roots of oak and hornbeam, are burning therein at one time, the fumes of which roll out in volumes filling our houses with noxi-

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gases, even when our doors and windows are shut. The louvre boards from which the effluvium escapes are at the same elevation as our bedroom windows, and there is no chimney-shaft to carry the effluvium away from our abodes.

Four physicians, viz.—Dr. Godfrey, 33, Finsbury Square; Dr. Bate, 412, Bethnal Green Road; Dr. Tripe, 172, Richmond Road, Hackney; and Dr. Simpson, 233, Hackney Road—have certified the smoke-house a public nuisance, and greatly injurious to health. Numbers of chemists in this neighbourhood have affirmed the same thing. The Vestry—men who know no more of chemistry than a codfish—having been applied to repeatedly by the inhabitants, have not only persistently refused to abate or remove the pest, but have always avowed themselves the defenders and patrons of it. We have also petitioned the Local Government Board, but they declare themselves powerless to do anything except to endorse the decision of the Vestry. Therefore our health is being wantonly destroyed without remedy, because this is too poor a neighbourhood for us to be able to bear the legal expenses necessary to suppress the nuisance which was brought to us, for we did not come to it, and our removing from it would in many cases involve the breaking up of our homes, and the ruin of our business, with the chance of some other nuisance equally pernicious being brought to us in whatever other place we might remove to. If this is Vestry and Local Government Board management, of what use is either of them? So far as our health is concerned we could not be worse off under Turkish despotism. —I am, &c.,

R. M. Gurnell.

17, Peel Grove, Old Ford Road, Bethnal Green,
October 29, 1872.

A MODIFICATION OF MOHR'S BURETTE.

To the Editor of the Chemical News.

Sir,—In reference to the letter of Mr. Edward Collens in your Paper of the 24th inst., in which he claims to have adopted the modification of Mohr's burette which was published in your previous number, we beg to say that having referred to his paper we at once admit the justice of his claim, and regret that we were not aware of it when we sent our description of what we believed to be quite new.

We are still of opinion that our plan in its details will be found the more convenient of the two, as it neither involves the long glass tube (with its great liability to fracture), nor any material alteration of the burette; but, nevertheless, the utmost we can claim is to have *improved* the arrangement.

Having said this, we feel the more at liberty to express our surprise at the objections urged against this plan, as in practice we find it nearly perfect. The leakage is absolutely *nil* in moderate sized burettes. The air bubble is less than in the ordinary arrangement, and the difficulty in regulating the flow from a large orifice can be effectually overcome by applying a screw pinch-cock in addition to the ordinary one.—We are, &c.,

M. Heriot,
R. Biggs.

A MODIFICATION OF MOHR'S BURETTE.

To the Editor of the Chemical News.

Sir,—Permit me to reply to your correspondent, who recites his experience on the above subject as gained in Messrs. Vernon Harcourt and Esson's investigations.

His first charge, which relates to the changes of temperature influencing the readings, is perfectly correct, but the error from this source is not such as to condemn the burette. The temperature of a laboratory is not, as a rule, subject to violent fluctuation; nor, at least in the majority of cases, is it necessary, when using a burette, to preserve the same reading hour after hour.

His second objection, viz., the difficulty experienced in delivering single drops by this arrangement, can be completely overcome by substituting a screw-clamp for the ordinary pinch-cock—such things are to be obtained of the apparatus dealers; and by its use a whole burretteful of fluid may, with the greatest ease, be delivered drop by drop, either fast or slow, without the clumsy suggestion of your correspondent's, which would defeat its own end by causing the instrument to drop after the supply of air had been cut off.

It is hardly necessary to reply to his third objection. A chemist who cannot fit a cork into a half-inch tube, and pass another and much smaller tube through it sufficiently tight to sustain a pressure of, say, 1 lb. on the square inch, is scarcely an authority on manipulation.

I quite agree with his remarks upon the superiority of the glass stop-cock modification, but every laboratory is not fitted with these. The real use of the modification in question is the ready means it affords chemists of converting their Mohr's burettes in a few minutes into instruments capable of being used with any test-liquors, an advantage which might have been disregarded had your correspondent's remarks not been replied to.—I am, &c.,

Edward Collens.

Birmingham Vinegar Brewery,
October 28, 1872.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, October 28, 1872.

This number contains the following original papers and memoirs more particularly relating to chemistry:—

Researches on Fermentation.—E. Fremy.—A reply to a question by Pasteur. An animated debate followed the reading of the paper at the meeting.

Researches on Crystalline Dissociation; Alums.—P. A. Favre and C. A. Valson.—The continuation of an exhaustive essay on this subject, elucidated by a series of tables.

New Studies on Valerianic Acid and its Preparation on the Large Scale.—I. Pierre and E. Puchot.—Valerianic acid, obtained by the oxidation of amylic alcohol, and concentrated as much as possible, boils at 178°, and has at 0° a sp. gr. = 0·947, and at 147·5° = 0·8095; the acid contains 1 equivalent of water, which cannot be eliminated by distillation. When in the presence of an excess of water, it boils at between 99·8° and 100°, forming vapours, which, by their condensation, yield two distinct layers of liquid; the lower layer is an aqueous solution of the acid, and the upper one is a hydrate of the acid; the proportion of these layers to each other is as 23 to 77. Valerianic acid causes the plane of polarisation to deviate in the same direction as crystallised sugar, while amylic alcohol does the reverse.

New Studies on Butyric Acid.—I. Pierre and E. Puchot.—Butyric acid, obtained by the oxidation of butyric alcohol, boils at 155·5° when quite concentrated, and has at 0° a sp. gr. = 0·9697, and at 139 = 0·822; this acid does not act upon polarised light. The formula of dry butyrate of baryta is $C_8H_7O_3,BaO$. Ethylic butyrate boils at 113°, and has at 0° a sp. gr. = 0·89, and at 100° = 0·779. Methylic butyrate boils at 93°, and has at 0° a sp. gr. = 0·9055.

Note on the Purple of Cassius.—H. Debray.—Reserved for full translation.

Smelting of Platinum.—H. Violette.—The author describes a small blast-furnace constructed by him at a chemical work at Lille, and communicating with the factory chimney; by the aid of this furnace the author states that he has been able to smelt 50 grms. of platinum placed in a crucible made of graphite placed in a fire-clay crucible. The heat generated is, according to the author, exceedingly great, although the cubical capacity of the furnace is only 45 litres. Coke was first used as fuel, but the author has found it better to use the graphite, as it does not contain ash. There is added to this paper a footnote by the Perpetual Secretary of the Academy, who asks

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whether it is not possible that the platinum may have taken up a trace of carbon, silicium, or sulphur, whereby its fusion-point is lowered.

Chemical Researches on the Leaves of the Eucalyptus Globulus.—Dr. Rabuteau.—The author states that these leaves contain no alkaloid.

Researches on the Physiological Theory of the Alcoholic Fermentation set up by Beer Yeast.—A. Béchamp.—The contents of this monograph are not suited for abstraction.

Annales de Chimie et de Physique, November, 1872.

This number contains the following original papers and memoirs:—

Simple Reactions Limited by Inverse Action; Application to the Conversion of the Phosphorus.—G. Lemoine.—The first portion of an exhaustive monograph, elucidated by algebraical and chemical formulæ and tabulated forms, and divided into the following sections:—Non-limited simple reactions; dissociation, homogeneous system; dissociation, non-homogeneous system; allotropic conversion of phosphorus.

Researches on Aromatic Combinations.—Dr. A. Wurtz.—The second instalment of this memoir contains the following chapters:—Synthesis of aromatic acids; synthesis of benzoic and toluic acids; dibenzyl-carboxylic acid; salts of this acid.

New Locality for Amblygonite; and on Montebrasite, a New Phosphate of Alumina and Hydrate of Lithia.—M. Des Cloizeaux.—This essay, illustrated by woodcuts, is in substance the same as that already quoted from the *Comptes Rendus* (see Chemical News, vol. xxiv., p. 97).

Silicic Mercaptan and a Chlorobromide of Silicium.—C. Friedel and A. Ladenburg.—After referring to the researches of I. Pierre on chlorosulphuret of silicium, the authors state that they prepared a larger quantity of that substance, care being taken to render it pure; on continuing their researches they found that the compound discovered by M. Pierre is a chlorosulphydrate of silicium which may be viewed as a terchloride of hydrosulphuric acid; this body is a limpid colourless liquid, which boils at 96°, exhibits the odour of sulphuretted hydrogen and hydrochloric acid, and is decomposed by exposure to air, the two volatile acids escaping, and silica being deposited. Absolute alcohol decomposes this compound at the ordinary temperature, hydrochloric acid being set free; the formula of this compound is $SiCl_3SH$. The chlorobromide of silicium, $SiCl_3Br$, is a colourless liquid, decomposed by the addition of water into silica and chlorhydric and bromhydric acids; boiling-point, 80°; vapour density, 7·25 (theoretically 7·42). The chlorosulphydrate of silicium may be considered as analogous to the methylic mercaptan, CH_3SH.

Mixed Silico-Acetic Anhydride.—C. Friedel and A. Ladenburg.—After first referring to the labours of Gerhardt, Kaemmerer, Carius, Menschutkine, and others, on mixed mono- and poly-basic anhydrides, the authors describe the preparation of this compound by the reaction of chloride of silicium upon acetic or anhydrous acids; this reaction is elucidated by the following formulæ:—

$$SiCl_4 + 4(C_2H_4O_2) = SiO_4(C_2H_3O)_4 + 4HCl, \text{ or—}$$
$$SiCl_4 + 4(C_2H_3O)_2O = SiO_4(C_2H_3O)_4 + 4C_2H_3OCl.$$

The silico-acetic anhydride is a white crystalline body, very hygroscopic, and decomposed by water; under reduced pressure it may be distilled without decomposition; it fuses at 110°, and boils at ordinary atmospheric pressure at 170°, but is then decomposed. The formula of this body is $Si(C_2H_3O)_4$; alcohol decomposes this substance, with formation of acetic ether and deposition of silica.

Bulletin de la Société Chimique de Paris, September 1 and 15, 1872.

This number contains the following original papers and memoirs:—

Compounds of Yttrium and Erbium.—P. T. Clève and O. Hoeglund.—The first instalment of a monograph on this subject, divided into the following sections:—Introduction, containing a review of the labours of different *savants* on these metals, beginning with the discovery by Gadolin of yttria, in 1794, in a mineral named gadolinite; atomic weight of yttrium, estimated according to the method of Bahr and Bunsen, and found by the authors to be equal to 59·7 (O=16); atomic weight of erbium, equal to 113·7; oxide of yttrium; hydrate of yttrium; oxide of erbium; hydrate of erbium, $2(ErH_3O_3)+H_2O$; salts of yttrium; salts of erbium. This portion of the essay is elucidated by a large number of complex formulæ, and also contains the detailed description of a number of double salts of the metals.

Some Derivatives of Tetrachloride of Naphthaline.—E. Grimaux.—By heating, under pressure, pure tetrachloride, which fuses at from 179° to 180°, with water (30 parts to 1 of the tetrachloride) a compound is formed, which the author terms bichlorated naphthydrenic glycol, $C_{10}H_8Cl_2(OH_2)$, a solid crystalline substance, difficultly soluble in cold water, more soluble in boiling water, and readily soluble in alcohol and ether. With chloride of acetyl, this body yields a diacetate, also a solid crystalline body—

$$C_{10}H_8Cl_2\left\{\begin{matrix}OC_2H_3O\\OC_2H_3O\end{matrix}\right.$$

soluble in alcohol and ether, and fusing at between 130° and 131°. With chloride of benzyl, the bichlorated naphthydrenic glycol yields a dibenzoate—

$$C_{10}H_8Cl_2\left\{\begin{matrix}OC_7H_5O\\OC_7H_5O\end{matrix}\right.$$

which, on being treated with alcoholic potassa solution, forms benzoic acid. When the bichlorated naphthydrenic glycol is distilled with hydrochloric acid, there is formed chlorated naphthol, $C_{10}H_6ClOH$, a ***olid body, soluble in boiling*** water, and fusing at 109°; the formation of this compound is explained by admitting that an intermediate compound chlorhydrine—

$$C_{10}H_8Cl_2\left\{\begin{matrix}Cl\\OH\end{matrix}\right.$$

$$C_{10}H_8Cl_2\left\{\begin{matrix}OH\\OH\end{matrix}\right. + HCl = C_{10}H_8Cl_2\left\{\begin{matrix}Cl\\OH\end{matrix}\right. + H_2O$$

is first formed; this intermediate chlorhydrine has not been isolated. The author devotes a large portion of this essay to a theoretical discussion on the formation of the chlorated naphthol. Treated with strong boiling nitric acid, the bichlorated naphthydrenic glycol yields a nitro-compound; with dilute nitric acid, phthalic acid is formed. By treatment with nitrate of silver, tetrachloride of naphthalin yields a solid yellow-coloured body, $C_{10}H_8Cl_2O_2$, insoluble in water, fusing at from 195° to 196°.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, July 4, 1872.

Extraction of Grease from Bones.—Lichtenberger.—The bones are first crushed, next treated with high-pressure steam, and to the semi-gelatinous mass thus formed is added hydrochloric acid (2 per cent), with which the material is boiled; by this operation the fat is separated and, floating on the top of the boiling liquor, is readily collected, and further purified by treatment with boiling water, a very small quantity of caustic soda having been added. Next, the grease (a fluid oil-like substance) is treated with animal charcoal, and, lastly, filtered.

Remarkable Instance of Disaggregation of Metallic Tin.—Dr. Oudemans.—It appears that a quantity of Banca tin was sent last winter by rail from Rotterdam to Moscow; on its arrival the metal was all converted into a powder, which, on being submitted to heat (somewhat above the fusion-point of the metal), did not become molten and re-converted to its pristine state, owing to the formation of a large quantity of oxide. Analysis proved the powder to be pure tin containing only 0·3 per cent of foreign metals (lead and iron). The author is of opinion that the blocks of tin were converted into powder by the combined action of cold and vibration during the journey by rail.

Process of Titration of Defecated Beet-Root Juice.—V. Vivien.—The author describes a method of testing beet-root juice for the purpose of ascertaining whether or not the excess of lime employed in the process of defecation of the juice has been properly removed from that liquor by the means industrially applied for that purpose. The author recommends the use of pure sulphuric acid, of which he takes 8·75 grms. to the litre of water; this solution is tinged red with a neutral tincture of litmus, and next diluted with 9 times its bulk of pure water. This liquid neutralises exactly its own bulk of clear defecated beet-root juice, when containing 5-10,000ths of lime. In order to test the beet-root juice, it is poured into a graduated tube made for the purpose, and the dilute sulphuric acid is added from a graduated pipette until a bright red colour is produced; if it is necessary to add an equal bulk of acid, the juice then contains ½ grm. of lime to the litre (equal to 5-10,000ths), but, if only required for the production of the red hue to, say, the third graduation of the tube, the juice still contains 2-1000ths of lime.

Artificial Miniature Volcano.—Dr. Hochstetter.—After referring briefly to the well-known experiments of Lemery, the author states that when sulphur is molten under water by the aid of high pressure (3 atmospheres=45 lbs. to the square inch), the sulphur absorbs some water, which is next driven off when the sulphur cools down, and the emission of steam is accompanied by explosions and evolution of fumes, whereby in the sulphur, provided the quantity operated upon is sufficiently large (not less than 50 kilos.), an upheaving takes place, and formation of craters, as well as emission of molten sulphur, thus simulating lava.

Benzoic Acid in Ammoniacal Gas-Water.—H. Reidsch.—By first treating the gas-water at 50° with sulphate of lime, the carbonate of ammonia contained in that liquid is entirely decomposed, and there is obtained a solution of sulphate of ammonia strongly impregnated with tar compounds, which are separated with difficulty from the ammoniacal salts; but if the liquid is first evaporated at a gentle heat until all the water is expelled, and then further heated in a porcelain crucible covered with a small piece of mica, there is eliminated some benzoic acid in crystalline state, which adheres to the piece of mica.

Annalen der Chemie und Pharmacie, No. 11 and 12 (double number), 1872.

This number contains the following original papers and memoirs:—

Action of Sodium on Crystalline Dibrombenzol.—Dr. F. Riese.—The results of a series of experiments to ascertain the nature of the compounds which are generated by the action of sodium upon dibrombenzol.

On β-Dibrombenzol.—Dr. F. Riese.—This body in pure state is a clear, mobile, and refrangible liquid, exhibiting an aromatic odour, soluble in cold alcohol, ether, and benzol in every proportion, and not congealed at −27°; when converted into a mononitro-compound the author found that it is not identical with the dibrombenzol obtained by Kekulé, which fuses at 84°, while the former fuses at 58°, and distils over without alteration at 296°.

Observations on the so-called Anhydrides of Lactic Acid.—J. Wislicenus.—This exhaustive monograph, elucidated by complex formulæ and tables, is divided into the following sections:—Anhydrisation *(anhydrisirung)* of lactic acid at the ordinary temperature; anhydrisation of lactic acid at higher temperatures; the nature of the so-called anhydride of lactic acid; decomposition of the

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acid anhydride by water. The results of these researches may be summarised as follows:—Before all the water present in a solution of lactic acid has been evaporated, some anhydride is present in the solution, and the quantity of that anhydride increases as the water decreases; pure lactic acid (formula $C_3H_6O_3$) does not therefore exist. When lactic acid is continuously kept in a dry atmosphere there is formed, even at the ordinary temperature, an anhydride and also a lactide. The author thinks it is probable that the lactic acids form a chemical compound with water in the same manner as acetic, formic, and valerianic acids, which form trihydrates corresponding to the formula:—

$$\begin{matrix} C_nH_{2n+1} \\ | \\ C-OH \\ | \\ OH \end{matrix}$$

and have a higher boiling-point than the monohydrates—

$$\begin{matrix} C_nH_{2n}+ \\ | \\ C=O \\ | \\ OH \end{matrix}$$

which, however, become partly decomposed by distillation, while water is eliminated *(abgespaltet)*.

On Bichlor-Ether.—Dr. H. Abeljanz.—This monograph is chiefly written to correct the labours of Lieben; it contains a large number of complex formulæ, and is divided into the following sections:—Introduction, treating on the preparation of the bichlor-ether, and on the products obtained by the action of dry hydrochloric acid gas upon aldehyde, and by the action of dry chlorine upon ethyl-ether; action of pentachloride of phosphorus upon bichlor-ether; decomposition of bichlor-ether; decomposition of bichlor-ether by alkali; general review of the results exhibited in a large number of lengthy and complex formulæ.

On Diphthalyl.—Dr. E. Ador.—This exhaustive essay treats on the preparation of diphthalyl by causing finely-divided metallic silver to act upon phthalyl chloride; the purified diphthalyl is a solid crystalline body, quite insoluble in water, scarcely soluble in alcohol and ether, but somewhat soluble in chloroform, sulphide of carbon, and fluid hydrocarbons; the best solvents for it are phenol and concentrated sulphuric acid; it fuses at 300°; its simplest formula is $C_9H_5O_2$. Action of alkalies upon diphthalyl; diphthalyl-aldehydic acid; diphthalyl acid; salts of this acid; capability of oxidation of diphthalyl acid; behaviour of diphthalyl-aldehydic and of diphthalyl acid in a higher temperature; action of pentachloride of phosphorus and of bromine upan diphthalyl; by-products of its preparation.

Some of the Cyanogen Derivatives of Aceton.—Dr. F. Urech.—It appears that the author, who briefly alludes to the labours of Morkownikoff, Städeler, Dr. Frankland, Duppa, and others on this subject, was desirous of preparing trimethylen-dicarbonic and dimethyl-malonic acids, starting from acetonic acid, first to be converted into α-brom-isobutyric acid. The monograph is divided into the following sections, all copiously elucidated by lengthy and complicated formulæ:—Action of anhydrous hydrocyanic acid, of nascent hydrocyanic acid, of cyanide of potassium, of cyanate of potassa, and of hydrochloric acid upon aceton; acetonyl-urea; splitting up of acetonyl-urea by acids; α-amido-isobutyric acid; hydrochloro-α-amido-isobutyric acid; synthesis of acetonyl-urea from its products of splitting up *(spaltungsproducten)* by the aid of acetonyl-uraminic acid; general review exhibited in a large number of formulæ.

Constitution of Sodium Ethylate.—A. Laubenheimer.—This paper treats more particularly on the constitutional formula of sodium ethylate, and the author states that, although otherwise agreeing with the excellent researches of Professor Wanklyn on this subject, the formula of sodium ethylate should be $C_2H_5.ONa$ instead of $C_2H_5Na.OH$.

Behaviour of Milk-Sugar with Permanganate of Potassa.—A. Laubenheimer.—The researches recorded in this essay were made partly to try whether it would be possible to obtain isomalic acid from milk-sugar, and partly to ascertain whether lactose is or is not completely oxidised, when in alkaline solution, by permanganate of potassa, it being premised that 1 molecule of milk-sugar requires for complete oxidation 24 atoms of oxygen—

$$C_{12}H_{12}O_{11},H_2O+24O=12CO_2+12H_2O.$$

The result of a series of experiments shows that lactose is slowly, but nearly completely, oxidised at the ordinary temperature, and rapidly at boiling heat of the solution, being entirely converted into carbonic acid and water. The formation of isomalic or malic acids from sugar of milk was not observed, but the author obtained carbonic and oxalic acids and an acid which, although not obtained in sufficiently pure state for analysis, appears to be akin to gallactinic and pectolactinic acids, the formulæ of which are, respectively, $2HO,C_{14}H_8O_7$ and $2HO,C_{16}H_8O_{10}$.

Presence of Benzyl Alcohol in Fluid Storax.—A. Laubenheimer.—After briefly referring to the researches made on storax by Bonastre, E. Simon, E. Kopp, Toel, Scharling, and others, and stating that storax, in addition to resins, contains styrol, C_8H_8, cinnamic acid, $C_9H_8O_2$, styracin (cinnamic acid-cinnamin ether), $C_9H_7(C_9H_9)O_2$, the author details some researches made with a preparation obtained by the saponification of impure styracin, and kept in the collection of chemical preparations of the University of Giessen. Among the products of a careful fractional distillation the author found a small quantity of benzyl alcohol, and also an alcohol, $C_9H_{12}O$, boiling at 243°, and cuminal alcohol, $C_{10}H_{14}O$.

Ethylic Ethers of Fumaric Acid.—A. Laubenheimer.—It appears that, when fumaric acid is heated with absolute alcohol under pressure to 120°, an ethylic ether of that acid is readily formed; this substance is in pure state a solid body, which, on analysis, was found to be the acid ether of the acid, or ethyl-fumaric acid—

$$C_4H_3O_3\left\{\begin{matrix}OC_2H_5\\OH\end{matrix}\right.$$

This mode of its preparation is, however, attended with loss of material, and the author prefers to prepare it by passing hydrochloric acid gas into a boiling alcoholic solution of malic acid, but in that case the purification of the ether becomes rather a complicate affair.

Reduction-Products of Silicic Acid Ether, and on some of its Derivatives.—A. Ladenburg.—This exhaustive monograph is divided into the following sections:—General introduction and review of the labours of other *savants*; silicium-monethyl or silico-propion series; silicium-diethyl series; silicium-triethyl or silico-heptyl series; silicium-tetra ethyl series.

Nonylic Acid from the Octyl Alcohol of Heracleum Oil.—Th. Zincke and A. Franchimont.—After referring to their researches on heracleum oil and the alcohols therein contained, observing that the octyl alcohol present in the oil has also lately been discovered by Dr. L. van Renesse in the essential oil obtained from *Pastinaca sativa*, the authors treat on nonylic acid, $C_9H_{18}O_2$, in pure state a colourless oily fluid, boiling at 254°, sp. gr. at 17·5° = 0·9065, difficultly soluble in cold water, but slowly distilled over with the vapours of boiling water; at a low temperature nonylic acid becomes solidified, and then melts at 10°. The preparation of this acid from the octyl alcohol is given in detail, as is also the description of the salts which this acid forms with bases; the constitution of this acid is discussed at length, and there is added to that portion of the essay a tabulated form exhibiting the boiling-points of a series of acids belonging to the same series of bodies, and of their ethylic ethers.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, November, 1872.

This number contains no original papers relating to chemistry; we call attention, however, to the following memoirs:—

Report on a Modérateur Aspirateur Hygiénique to be Applied to Stoves and Heating Apparatus, and Invented by M. Henry.—H. Peligot.—The description, illustrated by engravings, of a simple and effective contrivance for carrying off the foul air from rooms where stoves are used, without creating a draught; the unpleasant odours of cooking operations are also discharged into the chimney.

Experiments made with Leaden Balls Discharged from Rifles.—Melsens.—A valuable contribution to balistics and the effects of leaden balls upon stone, brick, iron, soft substances, &c.

Preservation of Eggs.—A. Gaffard.—The fresh eggs are carefully placed in a mixture of 5 kilos. of alum dissolved in 5 litres of water, heated to from 45° to 50°, and left in that liquid for from thirty to forty minutes; the eggs are next drained, and in the meantime the solution of alum is heated to boiling-point. The eggs are again immersed in the liquid, and kept therein for from ten to fifteen seconds; after having been drained and cooled they are packed in either dry bran, sawdust, cork-dust, sifted ashes, or in cotton-wool, and may be kept fresh for a whole year.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 15, 1872.

This number contains the following original papers and memoirs:—

Coerulignon, a By-Product of the Manufacture of Wood-Vinegar.—C. Liebermann.—The substance designated as coerulignon is so called owing to its blue colour; it has recently been discovered during the process of purification of the crude wood-vinegar or pyroligneous acid in the factory of Th. Lettenmayer, near Kōnigsbronn (Prussia). We intend to give a full translation of this paper.

Oxidation of Camphor Cymol in the Animal Body.—M. Nencki and E. Ziegler.—This paper records the results of experiments made upon dogs and men by administering doses of cymol prepared from camphor. The authors found in the urine, by a complicated process of purification, terephthalic acid and cuminic acid, being similar to the products of the artificial oxidation of these substances by chromic acid.

Products of Reduction of the Orthoformic Ether.—A. Ladenburg.—The result of the reduction of orthoformic ether by means of zinc-ethyl and sodium is, after a complicated process of operation, probably propional and a heptyl hydruret, $CH(C_3H_5)_3$, which the author calls triethyl-methan, a colourless liquid, exhibiting an odour somewhat like petroleum, boiling at 96°; sp. gr. at 27° = 0·689.

Application of Electrolysis to the Estimation of the Molecular Weight of Substances.—A. Ladenburg.—The contents of this paper are written to correct the views of Paterno (see CHEMICAL NEWS, vol. xxvi., p. 71).

Influence of Caoutchouc Tubing upon the Illuminating Power of Coal-Gas.—K. Zulkowsky.—The main results of the investigation may be summarised as follows:—(1). When it is intended to estimate the illuminating power of coal-gas, the gas should not be made to pass, before reaching the test-burners, through india-rubber tubing. (2). The decrease of the illuminating power is due to the absorption of the heavy hydrocarbons by the tubing material. (3). This behaviour of cautchouc should be borne in mind when analyses of coal-gas and similar gas mixtures are to be made.

Constitution of Camphoric Acid.—F. Wreden.—A preliminary notice. The author first refers to the researches of Chapman, Thorpe, Fittig, Baeyer, and others, and then states that, according to his

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investigation, camphoric acid is a corresponding dimethyl-benzol homologue of Baeyer's hexahydrophthalic acid.

Contribution to the History of Bromide of Vinyl.—E. Fuchs.—Notwithstanding the high scientific value of this essay, its contents, elucidated by complex and lengthy formulæ, are not well suited for abstraction; an observation equally applicable to the following lengthy monograph:—

Affinity of Hydrogen to the Metalloids.—J. Thomsen.

(Meta ?)Chlorphenol and its Nitro-Derivatives.—A. Faust and H. Müller.—The preparation of monochlorphenol, by passing into pure molten phenol, is first described, and next the purification of the crude product. The pure monochlorphenol is a colourless oily fluid, not congealed below −15°, boiling at between 175° and 177°. It yields with nitric acid two isomeric mononitrochlorphenols; one of these—

$$C_6H_4[NO_2]ClO,$$

is partly an oily, partly a crystalline, body, fusing at 70°, difficultly soluble in water, but readily so in chloroform; it exhibits an odour like that of saffron, and forms crystalline salts with several bases; the other nitro-compound, $C_6H_4(NO_2)ClO$, is a solid crystalline body, fusing at 110° to 111°; it is identical with a chloronitrophenol obtained by Armstrong (*Journal of the Chemical Society*, x., 12, and *Zeitschrift für Chemie*, 1871, 591), and forms crystalline salts with several bases.

Chemical Processes which Obtain in Plants.—A. Emmerling.—Reserved for full translation.

Heptylic Acid from the Hexyl Alcohol of Heracleum Oil.—A. Franchimont.—After referring to some of his other researches on this subject, the author describes at length heptylic acid and several of its salts. The former is, at ordinary temperature, a colourless oily fluid, boiling at 223° to 224°; it solidifies at −18°, forming a crystalline mass, which becomes fluid at −8°; sp. gr. at 24° = 0·9212. Ethylic ether, prepared from the acid, absolute alcohol, and concentrated sulphuric acid, $C_7H_{13}(C_2H_5)O_2$; sp. gr. at 24° = 0·874; it boils at 187° to 188°, and is not solidified at −18°. Many of the salts of the heptylic acid are soluble only in strong alcohol.

Pentachlorbenzols.—A. Ladenburg.—This paper records a series of investigations for the purpose of controlling the statements by Jungfleisch and Otto. It appears that while the formulæ of both authors agree, there is a discrepancy as regards the boiling-points, and it would seem that there exists only one real pentachlorbenzol.

Dinitrobrombenzol and Phenyldiamin.—Th. Zincke and F. Sintenis.—This paper is not well suited for abstraction.

Some Derivatives of Diphenylmethan.—W. H. Doer.—Diphenylmethan, prepared by the action of finely-divided zinc upon benzyl chloride and benzol at boiling heat, is a crystalline body, exhibiting the smell of oranges, and fusing at 26°; it has been applied by the author for the preparation of—Dinitro-diphenylmethan—

$$C_{13}H_{10}(NO_2)_2,$$

a solid crystalline body, fusing at 183°; isodinitro-diphenylmethan, $C_{13}H_{10}(NO_2)_2$, also a crystalline body, insoluble in water, soluble in alcohol, ether, benzol, and acetic acid (glacial), fusing at 172°; tetranitro-diphenylmethan, $C_{13}H_8(NO_2)_4$; diamido-diphenylmethan—

$$C_{13}H_{10}(NH_2)_2;$$

diphenylmethan-disulpho acid, $C_{13}H_{10}(SO_3H)_2$; dinitro-benzophenon, $C_{13}H_8(NO_2)_2$; isodinitro-benzophenon, $C_{13}H_8(NO_2)_2O$.

This number contains a detailed account, written by A. Pinner, of the proceedings of the Chemical Section of the fiftieth annual meeting of the German Natural Philosophers and Physicians, held at Leipzig in August last; this meeting was very fully attended, and the proceedings bear testimony to the great progress made in chemical science in Germany. Many, if not all, of the papers read will be published *in extenso*.

NOTES AND QUERIES.

Oxychloride of Magnesium.—(Reply to T. F.)—The substance you allude to is not a cement, but a kind of artificial stone invented by Sorel. You will find ample information on the proper mode of preparing it in *Comptes Rendus*, vol. lxv., p. 102; *Mechanic's Magazine*, July, 1867, p. 52; *Dingler's Polytechnisches Journal*, Bd. 185, p. 292; and also in the CHEMICAL NEWS, vol. xxii., p. 9.

Chemistry in India.—Mention was made in the CHEMICAL NEWS of India as a field for chemists to seek employment in. Could any of your readers inform me what work is there for a chemist to do? *i.e.*, whether under Government, or academical? also as to where and to whom application for such employment should be made?—Ph.D.

PATENTS.

Communicated by Messrs. VAUGHAN and SON, Patent Agents, 54, Chancery Lane, London, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

3017. N. Bickford, Exmouth, Devon, "An improvement in the manufacture of soap."—Petition recorded October 14, 1872.

3052. J. Hargreaves and T. Robinson, Widnes, Lancashire, "Improvements in apparatus employed in the manufacture of sulphates of soda and potassa."

3057. J. J. Shedlock, Upper Holloway, Middlesex, "Improvements in apparatus for the treatment of hydrocarbon gases and vapours for illuminating and heating purposes."—Petitions recorded October 16, 1872.

3080. H. Bethel, Victoria Street, Westminster, "Improvements in the treatment of beer, in order to prevent and remove acidity."—Petition recorded October 18, 1872.

3094. E. C. Nicholson, Herne Hill, Surrey, "Improvements in the production of colours for dyeing and printing."

3095. A. P. Price, Lincoln's Inn Fields, Middlesex, "Improvements in the treatment of substances capable of being employed for the purposes of dyeing and printing."—Petitions recorded October 19, 1872.

NOTICES TO PROCEED.

1853. E. Abate, Naples, Italy, "Improvements in preserving food or organic substances, and also in the machinery or apparatus employed therein, parts of which machinery or apparatus are applicable for making ice, and for refrigerating purposes."—Petition recorded June 19, 1872.

1885. J. Horsley, Cheltenham, Gloucester, "An improvement in the manufacture of an explosive compound, and a new mode of firing explosive compounds."—Petition recorded June 22, 1872.

1905. W. E. Newton, Chancery Lane, "Improvements in the manufacture of vinegar, and in the acidulation or treatment of various liquids, and in the apparatus employed therein."—A communication from R. D. Turner and I. Vanderpool, New York, U.S.A.—Petition recorded June 24, 1872.

2046. E. P. H. Vaughan, F.C.S., Chancery Lane, "Improvements in the mode of utilising the waste gases of metallurgical and other furnaces."—A communication from F. Pernot, Paris, France.—Petition recorded July 6, 1872.

2487. W. Young, Magdalen Bridge, P. Brash, and A. Scott, Musselburgh, Midlothian, "Improvements in the destructive distillation of coal, shale, and other bituminous substances for the production of illuminating gas and of oils."—Petition recorded August 21, 1872.

2920. J. Saunders, and J. Piper, Cookley, near Kidderminster, Worcestershire, "Improvements in coating tin and terne plates, and in apparatus employed therein."—Petition recorded October 3, 1872.

3005. C. Lowe, Reddish, Lancashire, "Improvements in the treatment of coal-gas tars for the purpose of obtaining certain useful products therefrom."—Petition recorded October 11, 1872.

PATENTS SEALED.

1437. J. V. P. Lagrange, Boulevard de Strasbourg, Paris, "Improvements in the treatment of saccharine juices and syrups."—Dated May 11, 1872.

1454. T. Sheenan, Dunkirk, New York, U.S.A., "An improved process for steelifying iron."

1456. W. Clark, Chancery Lane, Middlesex, "An improved method of extracting anthracene contained in coal-tar and the pitch accruing therefrom, without either carbonising or decomposing the pitch."—Dated March 13, 1872.

1708. C. W. Harrison, and A. H. Harrison, High Holborn, Middlesex, "Improvements in the manufacture of gas for lighting and heating purposes, and in the apparatus employed therein."—Dated June 5, 1872.

2186. J. Thom, Chorley, Lancashire, and J. Stenhouse, Pentonville, London, "Improvements in treating fatty substances containing colouring matters, and in obtaining useful products therefrom."—Dated July 22, 1872.

FOREIGN PATENTS.

FRANCE.

95500. Boggio, "An alimentary product called 'fibrine.'"

95512. Jarosson and Muller-Pack, "A black aniline and other coal-tar dyes."

95517. Payne, "A composition for the manufacture of fire-bricks, crucibles, retorts, &c."

95522. The Aluminium Joint-Stock Company, "Obtaining double fluoride of sodium and aluminium (artificial cryolite), and double fluoride of aluminium and potassium."

95543. Gaffard, "Preserving eggs."

95557. Richard and Dupont, "Manufacturing soap-paste."

95558. Solway, "Improvements in the manufacture of carbonate and bicarbonate of soda and their sub-products, and apparatus belonging thereto."

95563. Anderson, "Improvements in treating skins or hides."

95578. Jones, "A mode of smelting or reducing iron oxides for obtaining the metal therefrom."

95581. Martin, "A direct process of puddling iron and other ores."

95586. Possoz, "Improvements in making and refining sugar."

95593. Unwin, "Improvements in the method or means of depositing nickel upon metals, and in the preparation of articles to be coated for the reception of the nickel coating."

95603. Digeon, "Applying the leaves and fruit of the carob tree."

95615. Knab, "A means of extracting successively all the useful substances from plants, wood, seeds, flowers, &c."

95625. Scala, "Improvements in indigo dyeing."

95656. Maderni, "Manufacturing so-called 'milk chocolate.'"

TO CORRESPONDENTS.

Delta.—It has not been isolated.

H. B.—We have often quoted the titles of books on the subject in our "Notes and Queries" or "To Correspondents" column.

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THE CHEMICAL NEWS.

VOL. XXVI. No. 677.

ON THE

PRODUCTION OF FURFUROL BY THE ACTION OF HIGH-PRESSURE STEAM UPON WOOD.

By GREVILLE WILLIAMS, F.R.S.

My friend, Mr. George Fry, in the course of some laborious researches upon woody fibre, has had occasion repeatedly to subject fir wood to the action of water at an elevated temperature and pressure, and it is to him that I am indebted for the opportunity of examining some of the products. The experiments were each made on 100 lbs. of wood, in small blocks. They were placed in an iron cylinder surrounded with a steam jacket: 100 gallons of water were then introduced, and, the openings having been closed, high-pressure steam was admitted to the jacket until the manometer indicated a pressure of 100 lbs. to the inch in the interior of the cylinder. This was maintained for four hours. At the end of that time the liquid, which had become strongly acid, was run off through a cooling apparatus, and introduced into a rectifying still. By careful and repeated rectifications, two principal products were obtained in addition to the acid fluid: these were methylic alcohol and an oil.

The methylic alcohol was identified by conversion into oxalate of methyl.

The oil had a fragrant odour, resembling furfurol, but also recalling that of turpentine and cymene: 100 lbs. of wood yielded 10 ounces. Its specific gravity at 11° was 1·020. On rectification its boiling-point steadily rose from 163° to 216° C. On immersion in a freezing mixture it separated into two layers. The upper one was colourless, and had a specific gravity of 0·8855 at 11°; or, sensibly the same as that of turpentine. After rectification over sodium it yielded, on analysis, numbers intermediate between those of turpentine and cymene. Its odour also resembled that of a mixture of those substances. This hydrocarbon, or mixture of hydrocarbons, which is formed in very small quantity, is now under study. The lower layer had a specific gravity of 1·0784 at 11°. It gave the same reaction as furfurol with aniline. It was carefully rectified, and the portion boiling between 163° and 171° examined. On standing over sticks of potash a solid crust accumulated, which was separated by agitation. As thus obtained, the substance was in the form of minute colourless crystals: they were analysed with the following result:—

0·3473 grm. of substance gave 0·5072 grm. of carbonic acid, and 0·0770 grm. of water.

0·6140 grm. of substance gave 0·3606 grm. of sulphate of potassium.

Or, per cent—

	Experiment.		Calculation.		
Carbon ..	39·83		C_5	60·00	39·97
Hydrogen ..	2·46		H_3	3·00	2·00
Potassium ..	26·37		K	39·14	26·05
Oxygen ..	31·34		O_3	64·00	31·98
	100·00			166·14	100·00

The substance was, therefore, pyromucate of potassium, which is well known to be a product of the action of hydrate of potassium or pyromucic aldehyde (furfurol).

Although the conversion of the heavier oil into pyromucate of potassium might be considered sufficient evidence of its nature, I sought to confirm the result by the preparation of furfuramide, especially as such an experiment would enable me approximatively to determine the amount of furfurol present in the crude oil. On treatment with excess of strong ammonia, and allowing the mixture to stand for 12 hours, it was converted into a mass of straw-coloured needles. These were filtered off, pressed between folds of filtering-paper, and gently dried. After re-crystallisation from alcohol, the following numbers were obtained on analysis:—

0·2488 grm. of substance gave 0·6111 grm. of carbonic acid, and 0·1098 grm. of water.

	Experiment.		Calculation.		
Carbon ..	66·99		C_{15}	180	67·16
Hydrogen ..	4·90		H_{12}	12	4·48
Nitrogen ..	—		N_2	28	10·45
Oxygen ..	—		O_3	48	17·91
				268	100·00

The substance was, therefore, furfuramide. In order to obtain an idea of the amount of furfurol present in the oil, I made some experiments to determine the yield of furfuramide; the mean result of four experiments being that 100 parts of the crude oil gave 39·3 of furfuramide, corresponding to 42·3 per cent of furfurol.

Stenhouse, in the course of his admirable researches upon furfurol and its isomers, has shown that furfurol is formed on distilling sawdust with dilute sulphuric acid.* I have not, however, found any notice of its having been prepared by the action of water alone upon wood, and the fact of its production under these circumstances will probably tend to modify our views as to its derivation.

As the quantity of crude furfurol obtained in this manner will probably before long be very large, and as, from the nature of the process, it will all be saved, the process indicated will doubtless be the best source of furfurol at present known, until that which is produced in the preparation of munjeet and garancine is no longer allowed to escape.

Star Chemical Works, Brentford,
November, 1872.

RESEARCHES ON THE ATOMIC WEIGHT OF THALLIUM.†

By WILLIAM CROOKES, F.R.S., &c.

In June, 1862, and in February, 1863, I had the honour to lay before the Royal Society communications on the subject of the then newly discovered metal, thallium. In these I gave an account of its occurrence, distribution, and the method of extraction from the ore, together with its physical characteristics and chemical properties; also I discussed the position of thallium among elementary bodies, and gave a series of analytical notes.

In the pages of the *Journal of the Chemical Society* for April 1, 1864, I collated all the information then extant, both from my own researches and from those of others, introducing qualitative descriptions of an extended series of the salts of the metal. I propose in the present paper to lay before the Royal Society the details and results of experiments which have engrossed much of my spare time during the last eight years, and which consist of very laborious researches on the atomic weight of thallium.

SECTION I.

On the Determination of Atomic Weights.

In determining accurately the atomic weight of a metal that stands so high in the scale as thallium, difficulties and sources of error which are comparatively small with elements of low atomic weight are magnified to serious proportions, and require more than ordinary care for their elimination. When so large a proportion of the compound

* Watts's "Chemical Dictionary," vol. ii., p. 751.

† Abstract of a Paper communicated to the Royal Society, June

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under analysis or synthesis consists of the body itself whose atomic weight is the one unknown quantity, it is evident that the almost unavoidable errors occasioned by impurity in the materials employed, the losses incident to imperfect manipulation, or the inaccuracies arising during the weighing from the omission of the corrections required by temperature, pressure, &c., will all find their way into the number which is finally considered to represent the atomic weight of the metal.

I have attempted two entirely different methods of arriving at the atomic weight of thallium. Had the results of these determinations differed materially, I should have extended the research to other methods; but as they so nearly agree, it appeared unnecessary to incur so great an additional expenditure of time and material with no reasonable prospect of getting any but confirmatory results. The first method, and that which I shall describe, consists in taking a known quantity of metallic thallium, dissolving it in nitric acid, and weighing the nitrate of thallium produced.

The second method consists in dissolving known quantities of sulphate of thallium in water, and ascertaining how much nitrate of barium is necessary to precipitate the sulphuric acid as sulphate of barium.

SECTION II.

Apparatus Employed.

The absolute weight of any substance may be found from its apparent weight in an atmosphere of 30 inches of mercury, and from its apparent weight under, say, 25 inches of mercury. But the best weighings are undoubtedly one in air at ordinary pressure and temperature, and one in a highly rarefied atmosphere,—it cannot be said *in vacuo*, owing to the difficulty of working under such a difference of pressure between the atmosphere of the balance and that surrounding it.

The Balances.

Two balances were used. That which I shall call the *air*-balance was made by Messrs. Keissler and Neu expressly for this work, and will clearly indicate a difference of 0·0001 of a grain when loaded with 1000 grains in each pan.

The second balance, which I shall call the *vacuum* balance, is almost a duplicate of the first, of 14 inch beam, with agate knife-edges and planes, made by Oertling. It is enclosed in a cast-iron case connected with an air-pump, and so arranged that I can readily weigh any substance in air of any desired density, the rarefaction being measured by a barometer gauge.

At first it was attempted to put nearly the correct weight into the pan, and then make the final adjustment by means of the rider. It was, however, soon found that a nearer approach to accuracy is to introduce a certain weight, and then to alter the pressure of the air until the balance shows equilibrium. Two weighings at different degrees of atmospheric pressure, varying by a considerable interval, give data upon which to calculate what the weight would be in a perfect vacuum.

The Weights.

A set of weights as ordinarily supplied by even the best instrument makers is never absolutely exact; however carefully they may be adjusted, the pieces of metal which respectively represent 1000 grains, 100 grains, 10 grains, &c., are only more or less approximations to the true weights. In most chemical analyses, the error arising from such inaccuracies in the weights used is so small in comparison to errors of manipulation, or to imperfections inherent in the chemical processes adopted, that it may generally be disregarded; but when the chemist has for his object the determination of an atomic weight, or is engaged in other researches demanding the highest refinement of accuracy which chemistry and physics can supply, then he is bound to neglect no correction which will increase the precision of the results.

The weights I employed were of platinum, made expressly for these investigations by Messrs. Johnson and Matthey. The platinum was quite pure; it was fused, cast, and then well hammered. The weights were adjusted by myself during May, June, July, and August, 1864: they were first roughly adjusted, and then the sp. gr. of each weight was taken. The weights were heated to redness in a bath of magnesia previous to ascertaining their sp. gr. The density of the larger weights was ascertained to the second place of decimals, and that of the smaller ones to the first place. The following are the results of the final adjustment, the weight *in vacuo* being calculated by the formula:—

W = weight in air,
w = weight in water,
a = sp. gr. of air as compared with water;

then—

$$x = \text{weight } in\ vacuo = \frac{W - aw}{1 - a},$$

where $a = 0{\cdot}001225$, and
$1 - a = 0{\cdot}998775$.

Results of the Adjustment of Standard Grain-weights (Platinum set).

Weights.	True Value in Air 30 in. 62° F.	Weight of Air displaced.	Volume in Water of Max. Density.
grs.	grs.	grs.	grs.
1000·	1000·000000	0·058271	47·51
600·	599·998340	0·035533	28·97
300·	300·000240	0·017501	14·27
200·	199·998910	0·011664	9·51
100·	99·991420	0·005887	4·80
60·	59·993232	0·000483	2·84
30·	29·999991	0·001668	1·36
20·	19·999984	0·001104	0·90
10·	9·998477	0·000490	0·40
6·	5·998268	0·000355	0·29
3·	3·000469	0·000171	0·14
2·	1·999839	0·000113	0·10
1·	0·998980	0·000055	0·04
·6	0·602350	0·000035	0·03
·3	0.303600	0·000017	0·02
·2	0·203240	0·000011	0·01
·1	0·098110	0·000005	0·004
·06	0·061472	0·000003	0·003
·03	0·030561	0·000002	0·002
·02	0·022884	0·000001	0·001
·01	0·014097	0·000001	0·0004
*·01′	0·009997	0·000001	0·0004
*·01″	0·009967	0·000001	0·0004

* Riders.

The value of each weight in air, plus the weight of air displaced, is, of course, the weight *in vacuo*.

The Glass.

The flasks and vessels used were of the hardest Bohemian glass, and as thin as they could be employed. When practicable, vessels of old green German glass were used; neither this nor Bohemian glass is practically affected by reagents.

No cork or luting was employed in the distillations, &c.; in most cases the apparatus was blown in one piece, and the operations performed in a vacuum. The apparatus, which was weighed, was entirely composed of glass suspended with platinum wire loops: fingers were never allowed to touch it after the first weighing.

The weight of tubes, bulbs, and flasks, even of hard Bohemian glass, constantly diminishes when the glass is long heated in a spirit- or gas-flame; this loss may amount to several thousandths of a grain in the space of two hours when a bulb of Bohemian glass 3 inches in diameter is exposed to a decided red heat in a gas flame. Following the suggestion of Professor Stas, I have obviated this source of error by employing a bath of pure magnesia; and I find that the weight remains constant even at a nearly white heat. I have likewise employed baths of lime with similar satisfactory results.

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The special apparatus that I have used are described in the processes in which they were required; I need scarcely say that in no case were materials of untried purity employed.

Improved Sprengel Vacuum Pump.

Before detailing the processes of the determination, it will be requisite to describe the means of producing a vacuum in the flasks and bulbs employed. In proceeding with the determinations, several additions and improvements have been made to the Sprengel pump as generally found in the laboratory. The apparatus, as thus arranged, is readily manageable, with certainty of obtaining a Torricellian vacuum.

SECTION III.

The Chemicals.

The detail of the processes of preparing the thallium and the reagents in a chemically pure state is too necessary to admit of useful abstraction.

SECTION IV.

Processes and Results.

The processes and manipulation necessary to the determination of an atomic weight are at all times difficult and delicate, but especially in the case of a metal such as thallium, so readily oxidisable. This strong tendency to combine with oxygen renders the ordinarily exact processes of weighing out pure metals inapplicable to the present purpose. The chances of contact with the oxygen of the atmosphere must be reduced to a minimum, and to this end it was found desirable to work *in vacuo*. For this purpose the series of bulbs shown in Fig. 11 have been blown. Pure thallium is introduced into *a*, the upper end of which is then sealed. The end *c* is also sealed up, and the horizontal tube *e* is connected to the Sprengel pump, and a vacuum obtained, the tube being then sealed at *f*. The thallium in *a* is now heated on a magnesia-bath to its point of fusion (561° F.), and when molten caused, by gently tilting the vessel, to flow by the narrow channel *d* into the lower bulb *b*, all oxide remaining in *a*. The channel *d* is now contracted before the blowpipe, and *a* removed. The bulbs then appear as in Fig. 12, and after cooling are carefully weighed in air and *in vacuo*. The fine point of a blowpipe-flame, caused to impinge upon the end of the tube at *g*, softens the glass, and the air, endeavouring to force its way into the bulbs, forms a capillary orifice. By heating the bulb, and immersing the orifice in the pure nitric acid, the acid is introduced into the bulbs *h* and the globe *b* until all the thallium has been dissolved. The most tedious part of the process then commences, the evaporation of the excess of free acid. For this purpose an apparatus is used of the form represented in Fig. 13: *a* is the apparatus, connected by a wide tube (*b*) and a narrower glass tube with a Woulfe's bottle (*c*); this is in connection with a Bunsen's water pump (*d*), having 15 feet fall of water, and capable of producing an exhaustion equal to 10 inches of mercury. In the course of time the nitrate of thallium is left in the form of dry white crystals. The pump is then stopped, and air allowed to enter the apparatus by opening the pinch-cock, *e*, connected with the chloride of calcium tubes, *f*. The nitrate of thallium is then treated with a solution of oxalic acid to reduce any pernitrate that may be formed, the crystals dried, fused, dissolved in water, again allowed to crystallise, the evaporation of the water being repeated under diminished pressure. When there is no longer a loss of weight, the nitrate of thallium is finally weighed, the air being exhausted from the apparatus. The apparatus is now of the form shown in Fig. 14, and is weighed at two different atmospheric pressures. The nitrate of thallium having been afterwards removed, the apparatus is alone weighed at two different pressures. There have thus been obtained:—

α. The weight of the glass + thallium.
β. The weight of the glass + nitrate of thallium.
γ. The weight of the glass alone.

Particulars of these weights are given in the next section.

SECTION V.

Calculation of the Results.

The formulæ by which I have calculated the weights from weighings at two different atmospheric pressures are given at length in the full description of the processes that I have the honour to submit to the Royal Society.

Collecting the data, we have:—

	grs.
True weight of thallium *in vacuo* ..	= 183·79[illegible]32
True weight of nitrate of thallium *in vacuo*	= 239·646c6[illegible]
True weight of glass	= 766·133831
(*a*) Weight of thallium according to true value of weights in air ..	= 183·783921
(*b*) Weight of nitrate of thallium in air (1005·425937 − 765·814578)	= 239·611359
(*c*) Weight of glass &c. in air	= 765·814578
Weights employed to balance (*a*) ..	= 183·8099
Weights employed to balance (*b*) (1005·4364 − 765·8081)	= 239·6283
Weights employed to balance (*c*) ..	= 765·8081

The reduction of the atomic weight from these data becomes a case of simple proportion; but the values found are absolute in so far only as the atomic weights of nitrogen and oxygen are correct. The atomic weights of nitrogen and oxygen have been usually represented by the numbers 14 and 16; but Professor Stas found these elements represented, according to observation, by—

Oxygen (O_3)	= 47·880
Nitrogen	= 14·009

or nitric acid $NO_3 = 61·889$. According to the old equivalents, $NO_6 = 62$.

Taking as data the series of weighings *in vacuo*, the quantity of nitric acid required to convert the thallium into nitrate is (239·646066 − 183·790232 =) 55·855834 grs.

We have, then, with Professor Stas's determination of the atomic weights of nitrogen and oxygen, the following proportion:—

Weight of Nitric Acid.		Weight of Thallium.		Atomic Weight of Nitric Acid.		Atomic Weight of Thallium.
55·855834	:	183·790232	::	61·889	:	x;

$\therefore x = 203·642$.

Let us see what would be the atomic weight of thallium if one or other of the corrections introduced into the above determinations had been omitted. The use of the old equivalent (= 62) for nitric acid, with the data derived from the weighings *in vacuo*, gives—

55·855834 : 183·790232 :: 62 : 204·007

as the atomic weight; but I cannot admit this number to be so nearly correct as 203·642.

If we take the corrected weighings in air of ordinary density, we have, with $NO_3 = 61·889$,

203·738.

With $NO_6 = 62$,

204·103.

Accepting the uncorrected weights, observed in air, we have with $NO_3 = 61·889$,

203·162.

With $NO_6 = 62$,

204·165.

The error of the last deduction, +0·523, is sufficiently large to show the necessity of neglecting no precaution in chemical manipulation, especially in a determination of this character. The largeness of these errors have an immediate bearing upon quantitative analysis; for they show that from data ordinarily given very varying results may be obtained. Chemists have to deal with much smaller quantities than a quarter per cent, particularly in organic analysis, where such a difference from the truth may lead to very erroneous reasoning.

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RESULTS.

Ten results of the most trustworthy weighings (with $NO_3=61{\cdot}889$) are* :—

Determination.	True Weights *in vacuo*. Weight of Thallium taken.	Weight of Nitrate of Thallium + Glass.	Weight of Glass.	Calculated Atomic Weight from these data.
	grs.	grs.	grs.	grs.
A.	497·972995	1121·851852	472·557319	203·666
B.	293·193507	1111·387014	729·082713	203·628
C.	288·562777	971·214142	594·949719	203·632
D.	324·963740	1142·569408	710·849078	203·649
†E.	183·790232	1005·366736	766·133831	203·642
F.	190·842532	997·33;615	748·491271	203·636
G.	195·541324	1022·176679	767·203451	203·639
H.	201·856345	1013·480135	750·332401	203·650
I.	295·683523	1153·947672	768·403621	203·644
K.	299·203036	1159·870052	763·734201	203·638

I wish it to be noted that I have made determinations with various weights of thallium. In ordinary analysis chemists are satisfied to take 5 or 10 grains of the substance under investigation: here I have gone to the very highest weight that can be entrusted with safety to the balance. The lowest weight of thallium taken is 183·790232 grains, the heaviest 497·972995 grains, the remaining determinations varying between these limits. It is hardly necessary to say that the purpose has been to eliminate the error arising from manipulation with small quantities, and to produce such variety in the results as renders the chances of coincidence of very small value.

Let me now tabulate the results of the determinations, with the view to ascertain severally their degree of approximation to the arithmetic mean :—

A.	203·666	+0·024
B.	203·628	−0·014
C.	203·632	−0·010
D.	203·649	+0·007
E.	203·642	+0·000
F.	203·636	−0·006
G.	203·639	−0·003
H.	203·650	+0·008
I.	203·644	+0·002
K.	203·638	−0·004

The arithmetic mean of the ten observations is

$$a=\frac{2036{\cdot}424}{10}=203{\cdot}642.$$

The probable error is 0·0022; and the probability that the true value lies between 203·632 and 203·652 is 0·99808, certainty being represented by unity.

I may therefore conclude that the atomic weight of thallium is, within the limits of error (as small as possible) of observation,—

203·642

Professor Stas has shown the hypothesis of Prout—that the atomic weights of the elements are severally multiples of the atomic weight of hydrogen—to be without the corroboration of experimental result. This view of the hypothesis is further borne out in the present investigation; for the number 203·642 cannot, within the limit of what has been shown to be the probable error, by any liberty be made to follow the hypothesis. Without doubt, when the atomic weights of all the metals are re-determined according to the standard of recent scientific method, it will be found that there are more exceptions to the hypothesis than commonly considered. Marignac gives, in his confirmatory discussion of Stas's experiments, and in his own results with calcium (40·21), lanthanum (94·13), strontium (87·25), analogous opposed evidence, as in the case of the weight found for thallium.

I have thus striven to eliminate all erroneous influence in the number I submit to the Royal Society as the atomic weight of thallium; and I shall be amply rewarded for my long labour if I can know that the determination has secured to researches of this character a nearer approach to the standard of truth.

The drawings appended to the complete paper comprise copies of :—

Fig. 1. The case of the vacuum balance.
2. The improved Sprengel vacuum pump.
3. Apparatus for preparing pure water under diminished pressure.
4. Apparatus for preparing nitric acid under diminished pressure.
5. Apparatus for preparing oxalic acid under diminished pressure.
6. Apparatus for preparing sulphuric acid under diminished pressure.
7. Stoppered tube in which thallium was weighed in the early determinations.
8. A series of bulbs.*
9. Another series of bulbs.*
10. Apparatus for sealing up thallium in hydrogen.
11. The first stage of selected glass apparatus.*
12. The second stage of selected glass apparatus.*
13. The Bunsen water pump and drying apparatus.
14. The third stage of selected glass apparatus.*

SOLVENTS FOR INDIGO.

By Dr. E. JACOBSEN.

SOME new solvents for indigo have lately been given by De Aguiar and Baeyer, and by Professor Wartha. To these I will also add a few which I have discovered. That aniline will dissolve indigo has been known several years, from my own experiments; but an equally good solvent for indigo is nitrobenzol, which, when heated with indigo, is coloured a deep violet-blue, and on cooling deposits flaky crystals, and then appears dark red, probably from red indigo.

In greater or less quantities, the following substances dissolve indigo at their boiling-points :—

Castor oil, acetone, hydrate of chloral, camphor, oil of turpentine, balsam of copaiba, cedar oil (oil of Juniper virgin), amylic alcohol, oil of lavender, white bees'-wax, Japanese vegetable wax, and Carnauba wax (from this last small flaky crystals precipitate).

The higher the boiling-point of the solvent, the redder is the appearance of the solution; so that bodies like acetone, amylic alcohol, and hydrate of chloral give a clear blue. Castor oil, cedar oil, &c., a violet-blue, and the different kinds of wax a purple-red solution. If kept for a short time at the boiling-point with white wax, the colour changes from scarlet to orange, and at last to a brown. The indigo is reduced by the formation of acrolein, and the solution retains its brown colour even on the addition of gasoline.

If powdered indigo is added to melting picric acid, the former will be decomposed with deflagration.—*American Chemist.*

University of London.—The following are lists of the candidates who have passed the recent second B.Sc. Examination:—*First Division.* Edward Albert Butler, B.A., private study; Charles Callaway, M.A., Cheshunt College; John Henry Poynting, Owens College; Ebenezer Geer Russell, First M.B., Guy's Hospital; Robert Harold Ainsworth Schofield, B.A., Lincoln College, Oxford, and Owens.—*Second Division.* Robert William Atkinson, University College and Royal School of Mines; Thomas Carnelley, Owens College; Alexander Irving, B.A., private study and School of Mines; Henry Elthington Price, private study.

* It should be noted that the arithmetic mean of *all* the readings, including the highest as well as the lowest result, in which doubt might arise as to success in manipulation, is 203·6.

† *Fully illustrated in the paper.*

* For the conversion of thallium into nitrate of thal-

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ON THE ECLIPSE EXPEDITION, 1871.*

By J. NORMAN LOCKYER, F.R.S., M.R.I.

(Concluded from p. 226).

I MUST now state very briefly some of the results of our work; and first, the certain results.

We were able to make out the structure of the corona. We know all about the corona so far as the structure of its lower brighter strata, that portion, viz., which I referred to in my lecture last year as being visible both before and after totality, is concerned. You may define it as consisting of cool prominences; that is to say, if you examine a prominence any day, without waiting for an eclipse, and then go to an eclipse and examine the lower portion of the corona, you will find the same phenomena, *minus* the brightness. You find the delicate thread-like filaments which you are now all so familiar with in prominences—filaments which were first thrown on a screen in this theatre; the cloudy light masses, the mottling, the nebulous structure, are all absolutely produced in the corona, as far as I could see it with a telescope with an aperture of 6¼ inches; and I may add that the portion some five minutes round the sun reminded me forcibly in parts of the nebula of Orion, and of that surrounding η Argus, as depicted by Sir John Herschel, in his Cape observations.

We have shown that the idea that we did not get hydrogen above 10 seconds above the sun is erroneous; for we obtained evidence that hydrogen exists to a height of 8 or 10 minutes at least above the sun; and I need not tell you the extreme importance of this determination. One of the proofs we have of that lies in this diagram, showing the observations made by Professor Respighi, armed with an instrument the principle of which I hope you are now familiar with.

Just after the sun disappeared, Professor Respighi employed this prism to determine the materials of which the prominences which were then being eclipsed were composed; and he got the prominences shaped out in red, yellow, in blue, and in violet light, a background of impure spectrum filling the field; and then, as the moon swept over the prominences, these images became invisible. He saw the impure spectrum and the yellow and violet rings gradually die out, and then three bright and broad *rings*, painted in red, green, and blue, gradually form in the field of view of his instrument; and as long as the more brilliant prominences were invisible on both sides of the sun, he saw these magnificent rings, which threw him in a state of ecstacy. And well they might.

These rings were formed by C and F, which shows us that hydrogen extends at least 7 minutes high, for had we not been dealing with hydrogen we should have got a yellow ring as well, because the substance which underlies the hydrogen is more brilliant than the hydrogen itself, and in addition to the red ring and the blue ring, which indicate the spectrum of hydrogen, he saw a bright green ring, much more brilliant than the others, built up by the unknown substance which gives us the Kirchhoff line, 1474.

Now, at the time that Professor Respighi was observing these beautiful rings by means of a single prism and a telescope of some 4 inches aperture, some 300 miles away from him—he was at Poodocottah, and I was at Bekul—I had arranged the train of prisms which you see here so that the light of the sun should enter the first one, and after leaving the last one should enter my eye. And what I saw is shown, side by side with Respighi's observations, in this diagram, in which I have separated the rings somewhat, so that there should be less confusion than in the actual observation. Here is Professor Respighi's first observation. He gets indications of C, D^3, F, and the hydrogen line near G. He was observing the very lowest, brightest region of all, and therefore 1474 was obliterated by the brightness of the continuous spectrum; but, as the eclipse went on, D^3 was entirely obliterated, and afterwards he got C and F building up rings together with 1474, which was not represented in the lower regions of the prominence—not because it was not there, but because, as I have already insisted, of the extreme brilliancy of the background. Now my observation was made intermediately, as it were, between the two observations of Professor Respighi's. Let me show the observations together.

Respighi ..	C	D^3		F	G	Prominences at beginning of eclipse.
Lockyer ..	C		1474	F	G	Corona at 80 seconds from commencement.
Respighi ..	C		1474	F		Corona at mid eclipse.

Note that I had no object-glass to collect light, but that I had more prisms to disperse it; so that with me the rings were not so high as those observed by Respighi, because I had not so much light to work with: but such as they were I saw them better, because the continuous spectrum was more dispersed, and because, with my dispersion, the rings—the images of the corona—therefore did not so much overlap. Hence, doubtless Respighi missed the violet ring which I saw, so faint, however, that both that and 1474 were almost invisible, while C shot out with marvellous brilliancy, and D^3 was absent.

These observations thus tend to show, therefore, that instead of the element—the line of which corresponds with 1474—existing alone just above the prominences, the hydrogen accompanies it to what may be termed a great height above the more intensely heated lower levels of the chromosphere, including the prominences in which the lower vapours are thrown a greater height. With a spectroscope of small dispersion attached to the largest mirror of smallest focus which I could obtain in England, the gaseous nature of the spectrum, as indicated by its *structure*, that is, bands of light and darker intervals, as distinguished from a continuous spectrum properly so called, was also rendered evident.

These are results of the highest importance, which alone are worth all the anxiety and labour connected with the expedition.

But there is more behind.

The photographic operations (part of the expense of which was borne by Lord Lindsay) were most satisfactory, and the solar corona was photographed to a greater height than it was observed by the spectroscope, and with details which were not observed in the spectroscope.

Mr. Davis was fortunate enough to take an admirable series of five photographs at Bekul, and Captain Hogg also obtained some at Jaffna; but I am sorry to say the latter lack somewhat in detail.

I have prepared two lamps, because I am anxious to exhibit the photographs two at a time, that you may compare one with the other. [This was done.] You see that, so far as the camera goes—and mark this well—the corona was almost changeless during the whole period of totality; this is true, not only for one place, but for all the places at which it was photographed.

I now exhibit two other photographs—one taken at Jaffna, and the other at Ootacamund. Actinically, the corona was the same and practically changeless at all the stations. You see that, though not so obvious as in the other case, there is the same similarity.

Before I leave the actinic corona, I am anxious to show you an image of it, taken during the American eclipse of 1869 in a camera exposed to the sun during the whole of the totality; to a certain extent, in our recent photographs we have reproduced what was photographed in 1869.

The solar nature of most, if not all, of the corona recorded on the plates is established by the fact that the plates, taken in different places, and both at the beginning and end, of totality, closely resemble each other, and much of the exterior detailed structure is a continuation of that observed in the inner portion independently determined by the spectroscope to belong to the sun,

* A Lecture delivered before the Royal Institution of Great Britain,

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While both in the prism and the 6¼ inch equatorial the corona seemed to form pretty regular rings round the dark moon, of different heights according to the amount of light utilised by the instrument, on the photographic plates, the corona, which, as I have before stated, exceeds the limits actually seen in the instrument I have named, has a very irregular, somewhat stellate outline, most marked breaks or rifts (*ignored by the spectroscope*), occurring near the sun's poles, a fact perhaps connected with the other fact that the most active and most brilliant prominences rarely occur there.

From the photographs in which the corona is depicted actinically, we pass to the drawings in which it is depicted visually. I would first call attention to two drawings made by Mr. Holiday, who formed part of the expedition, and in whose eye everyone who knows him will have every confidence.

First there is a drawing made at the commencement of the totality, and then a drawing made at the end. There is a wonderful difference between the drawings; the corona is in them very much more extensive than is represented actinically on our plates.

Here is another drawing, made by Captain Tupman, in which again we have something absolutely different from the photographs and from Mr. Holiday's sketches, inasmuch as we get an infinite number of dark lines extending down to the moon, and a greater extension than in the photographs, though in radial places the shape of the actinic corona and some of its details are shown.

Now the corona, as it appeared to me with the naked eye, was nothing but an assemblage of bright and dark lines: it lacked all the structure of the photographs, and appeared larger; and I have asked myself whether these lines do not in some way depend on the size of the telescope, or the absence of a telescope. It seems as if observations of the corona with the naked eye, or with a telescope of small power, may give us such lines; but that, when we use a telescope of large power, it will give, close to the moon, the structure to which I have referred, and abolish the exterior structure altogether, leaving a ring round the dark body of the moon such as Professor Respighi and myself saw in our prisms; and in the 6 inch telescope, in which the light was reduced by high magnification, so as to bring the corona to a definite ring some 5 minutes high; while Professor Respighi, using a 4 inch telescope and less magnifying power, brought the corona down to a ring something like 7 minutes high.

And here we have an important connection between spectroscopic and telescopic work. If we employ a telescope in which the light is small or is reduced by high magnification, we bring the corona to a definite ring, and perhaps here we have the origin of the "ring-formed" coronas.

Many instances of changing rays, like those seen by Plantamour in 1860, were recorded by observers in whom I have every confidence. One observer noted that the rays revolved and disappeared over the rifts.

We have next to deal with the polariscopic observations.

Mr. Lewis, in sweeping round the corona at a distance of 6′ or 7′ from the sun's limb, using a pair of compensating quartz wedges as an analyser, which remained parallel to itself while the telescope swept round, observed the bands gradually change in intensity, then disappear, bands of a complementary character afterwards appearing, thereby indicating radial polarisation.

Dr. Thompson at Bekul saw strong traces of atmospheric, but none of radial, polarisation, with a Savart. With the same class of instrument the result obtained by myself was precisely similar; while on turning in the Biquartz, at the top and bottom of the image of the corona, *i.e.*, near the sun's equator, faint traces of radial polarisation were perceptible for a short distance from the moon's limb. Captain Tupman, who observed with the polariscope after totality, announces strong radial polarisation extending to a very considerable distance from the dark moon.

Leaving the extreme outside of the corona as a question to be determined at some future time—and it can well wait—let us come to the base of the corona, and deal with the region to which I have already referred, close to the sun.

What was the general conclusion at which we arrived on this important point? Before I state it, let me tell you the instrumental conditions of the inquiry. We can use such a spectroscope as the one with which you are all familiar, and so arrange matters that the slit shall be carried by a clock, so that it may follow accurately the edge of the moon; but if the least variation in the rate of motion takes place, the observation is rendered almost valueless. But if we employ a spectroscope in which we sum up the light—do not localise the light, but throw it together—it does not matter whether your clock goes well or not, you are certain to have a result worthy of credit. But if you employ such an instrument as Professor Respighi employed, and abolish the slit altogether, the weight of any observations made with such conditions is very great.

Captain Maclear, who was observing with me at Bekul, has undoubtedly shown that, when the light of our atmosphere is cut off by the interposition of the dark moon, we see very many more bright lines than we do when this is not the case, the lines being of unequal height.

Mr. Pringle, also at Bekul, showed that at the end of totality many lines flashed into one of these instruments, carried under these difficult conditions.

Captain Fyers, the Surveyor-General of Ceylon, observing with a spectroscope of the second kind, saw something like a reversal of all the lines at the beginning, but nothing of the kind at the end.

Mr. Fergusson, observing with a similar instrument, saw reversal neither at the beginning nor the end.

Mr. Mosely, whose observations are of great weight, says that at the beginning of the eclipse he did not see this reversal of lines, Whether it was visible at the end he could not tell, because at the close the slit had travelled off the edge of the moon.

Professor Respighi, using no slit whatever, and being under the best conditions for seeing the reversal of the lines, certainly did not see it at the beginning, but he considers he saw it at the end, though about this he is doubtful.

From the foregoing general statement of the observations made on the eclipse of last year, it will be seen that knowledge has been very greatly advanced, and that most important data have been obtained to aid in the discussion of former observations. Further, many of the questions raised by the recent observations make it imperatively necessary that future eclipses should be carefully observed, as periodic changes in the corona may then possibly be found to occur. In these observations the instruments above described should be considered normal, and they should be added to as much as possible.

I had intended, if time had permitted me, to point out how much better we are prepared for the observation of an eclipse now than we were when we went to India, and how a system of photograph record should be introduced into the spectroscopic and polariscopic work; but time will not allow me to do more than suggest this interesting topic. I am anxious, however, that you should allow me one minute more to say how very grateful we feel for the assistance rendered by all we met, to which assistance so much of our success must be ascribed. I wish thus publicly to express the extreme gratitude of everyone of our Expedition to the authorities in India and in Ceylon for the assistance we received from them; and our sorrow that Admiral Cockburn, a warm and well-known friend to science, who placed his flag-ship at the disposal of the expedition, and the Viceroy, whose influence in our favour was felt in every region of India whither our parties went, and to whom we gave up our ship, are now, alas! beyond the expression of our thanks. We are also anxious to express our obligations to the directors and officers of

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the Peninsular and Oriental Company for the magnificent way in which they aided us. If they had not assisted us as they did, science would have gained very much less than she has done from the observations of the last eclipse.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 7th, 1872.

Prof. WILLIAMSON, Vice-President, in the Chair.

WHEN Messrs. R. Weaver, C.E., W. W. Fisher, Edward Kinch, and Walter Weldon, had been formally admitted Members of the Society, and the donations announced, the following names were read for the first time:—Messrs. Kigonari H. Yoshida, Francis H. Hobler, Sydney Lupton, E. W. Prevost, Ph.D., Thomas Williams, T. D. Fitmal, Joseph Lainson Wills, A. Percy Smith, Philip Braham, John Hollings Mitchell, Robert William Jones, A. Cameron Bruce, M.A.

For the third time—Archibald Liversidge, Esq., who was ballotted for and duly elected.

The first paper was "*On the Action of Charcoal on Organic Nitrogen*," by E. C. STANFORD. The author, in 1869, proposed a method of mixing excreta, fish offal, and other offensive matter, with charcoal, so as to deodorise them, and when dry to heat the product in retorts, thus obtaining the whole of the nitrogen as ammonia. Experiments were made to ascertain the truth of the current opinion that nitrogenous matters in contact with charcoal become oxidised, giving rise to nitric acid, which would of course render the process valueless. For this purpose mixtures of excreta and decaying animal matter with three different varieties of charcoal were prepared, and examined at different intervals during twenty-one months, but no nitric acid could be detected. The author therefore infers that charcoal mixed with nitrogenous organic matter acts simply as a dryer, and not as an oxidising agent, and that for all practical purposes there is but little loss of nitrogen in such mixtures.

The CHAIRMAN said it was interesting to find, from the records of the author's experiments on this important point, that the loss of nitrogen was so small. This method would doubtless be of great practical importance, especially as those products of oxidation generally believed to be formed by the action of the air did not occur.

There was also another short paper by Mr. E. C. STANFORD, "*On Iona Pebbles.*" These pebbles, of which analyses are given, are a variety of non-aluminous serpentine, of an olive-green colour.

Prof. MASKELYNE observed that not only the pebbles mentioned, but also other Iona minerals, had already been analysed, and the results published in the *Journal* of the Society.

The CHAIRMAN called the attention of the members to a beautiful specimen of bromocamphor made by Mr. Williams, which was remarkable as having been prepared at the ordinary pressure.

Mr. WILLIAMS said it was only necessary to keep the mixture of bromine and camphor at 130°, and, when the action was complete, to dissolve the crude substance in hot petroleum. On cooling the bromocamphor crystallised out, and the camphor remained in solution. Two or three crystallisations from alcohol rendered it pure. The large amount of hydrobromic acid given off rendered it much safer to operate at the ordinary pressure than in closed vessels. The speaker added that it was used medicinally, as a nerve sedative, in such diseases as *delirium tremens*.

A communication entitled "*Mineralogical Notices*," by Prof. STORY MASKELYNE and Dr. FLIGHT, was then read by the former. There were many specimens in the British Museum which were unique or almost so, and it was desirable to have them analysed, to ascertain what they really were, so as to discover, if possible, new localities for them, or, if they were not definite minerals, to abolish them. The first mentioned was isopyre, of which there were several specimens, varying in appearance but differing considerably in composition: probably the presence of ferrous oxide in all these varieties of opal may explain the mineralogical similarity to which their association, under the name of isopyre in our collections, is due.

A mineral named Percylite, after Dr. Percy, originally from Sonora, in Mexico, has also been obtained from another locality, namely, South Africa. That from Sonora had a notable amount of gold disseminated throughout the specimen, whilst the one from Africa contained horn silver. The author had also procured from South Africa a mineral of a chestnut-brown colour, which turned out to be remarkably pure vanadite. He also noticed some new Cornish minerals, a uranite from Redruth, and a specimen of a remarkable bluish-green, botryoidal, lustrous mineral, associated with quartz: on examination it was found to have the composition of prasine or ethlite, a member of the pseudo-malachite group, one of which—the normal pseudo-malachite—contains three equivalents of cupric hydrate, the others one or more equivalents of water substituted for the same number of equivalents of cupric hydrate.

Dr. WILLIAMSON thanked the authors for their valuable instalment of mineralological notices from the British Museum, and remarked that it was especially pleasant to chemists to hear that at least one mineral had been done away with. Chemically it would be of great interest if it were established that one molecule of water were replaced by one of cupric hydrate; for his part, he should have been inclined to imagine that one of cupric hydrate would have replaced two of water.

Prof. MASKELYNE replied that he did not mean to say that there was an actual replacement, but that in this group of minerals one contained three of water, another two water and one cupric hydrate, a third one water and two cupric hydrate, and so on.

Mr. SPILLER remarked that he was a pupil of Dr. Percy at the time that he was examining percylite, and some experiments had been made with the object of preparing it artificially, by immersing plates of lead in solutions containing cupric chloride and sulphates; perhaps Prof. Maskelyne could say whether this oxychloride of lead and copper had yet been produced artificially, like atacamite, in the flues at the great copper-mines in Chili.

Mr. ROBERTS then read a paper "*On the Specific Heat of Occluded Hydrogen*," by W. CHANDLER ROBERTS and C. R. A. WRIGHT, D.Sc., in which he stated that, until the experiments were concluded, they desired to abstain as much as possible from giving numerical values, but they might mention that the values for the specific heat varied greatly,—when the palladium was saturated with the gas it was as low as 4 between 0° and 100°; and that when the charge was low the specific heat was as high as 8 or 9,—which might, perhaps, be explained if we regard the first portions of gas absorbed as liquefied and the later portions as solid, the specific heat of a liquid body being greater than when it is in the solid state.

Professor WILLIAMSON said the Society would await with interest further particulars on this subject, as until the numerical data were given it could not be discussed. He would like to know, however, how far the experimental errors were likely to affect the numbers given.

Dr. WRIGHT replied that generally two or three experiments were made of each kind, and the difference between the results was extremely small, although he might observe that when the palladium had once been charged and the hydrogen pumped out, and then re-charged, a certain difference was observable in the second experiment, probably attributable to irregularity in the distribution of the

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hydrogen through the metal. But the main fact that there was a difference in the specific heat of the occluded hydrogen when the charge of the palladium was high, and when it was low was satisfactorily established.

Mr. J. A. R. NEWLANDS then made a communication "*On a Means of Preventing Explosions in Coal-Mines*," in which, after remarking that diminished atmospheric pressure was frequently the cause of explosion in coal-mines proposed to obviate this by having the upcast and downcast shafts covered by air-tight chambers, the one furnished with an outlet valve, and the other connected with pumping machines to force air into the mine. This might be done by air pumps, or by a ventilating fan, or by the Sprengel pump. In case of an escape of fire-damp a diminished pressure might first be produced in the mine, and the liberated fire-damp subsequently expelled by driving a current of air through the workings.

The CHAIRMAN said it was a matter of great importance and interest, not only to chemists, but to the public at large; the principle seemed to be a sound one, but he could not say whether the mechanical means would answer the purpose.

The last paper was "*On some Possible Reactions that yielded Negative Results*," by Dr. C. R. A. WRIGHT, giving an account of numerous reactions the author had tried but which had not given the desired results. He had made this communication with the view of saving the labour of other chemists who feel disposed to examine these reactions.

Professor WILLIAMSON said that chemists were not sufficiently in the habit of communicating negative results, for if they did it would often save much valuable time and labour. It was quite as much a chemical fact that no reaction took place under given circumstances, as when the reaction yielded some definite result. He supposed it was want of moral courage which prevented chemists recording their failures, and in this Dr. Wright had set us a good example.

The meeting was then adjourned until Thursday, the 21st inst., when Mr. Perkin will read a paper on "*Anthraflavic Acid*.

CHEMICO-AGRICULTURAL SOCIETY OF ULSTER.

THE usual monthly meeting of this Society was held on the 1st inst. in their rooms, Arthur Street, Major Crawford, J.P., presiding. The other members present were—Dr. Ritchie, J.P.; Dr. Hodges; W. R. Jackson, Esq.; and Robert M'Calmont, Esq.

New Members.

Dr. HODGES said that he had very much pleasure in informing them that since the last meeting he had received a letter from Sir Richard Wallace intimating his intention of subscribing £10 annually to the funds of the Society, and he also stated that he expected to occasionally take part in their meetings. He, therefore, proposed that Sir Richard Wallace be appointed a member of the Society.

The motion was unanimously adopted.

J. B. Price, Esq., J.P., was also appointed a member of the Society.

Discovery of the rare Metal Vanadium in the Iron Ores of the County Antrim.

Dr. HODGES stated that, in the alluvial basalt and iron beds of the North of Antrim, the presence of the metal titanium had been noticed by Mr. Riley, and also reported by himself. He wished, however, to make known to the Society that he had, a great many years ago, directed the attention of Mr. Fisher, the lessee of some of the rich ores of Glenravel, to the occurrence of another rare metal, vanadium, in specimens of the ores submitted to him for examination. The existence of vanadium in Irish ores had not previously been detected. The late Professor Thomas Thompson, of Glasgow, discovered it in combination with lead in a mineral brought to him by the well-known veteran mineral explorer, Pat Doran, from an old abandoned lead mine in the County of Wicklow. It has also lately been discovered in the basalt from the Giant's Causeway by Mr. Robert Apjohn.

The Whisky of the County Down.

With respect to his reports on the adulteration of whisky, Dr. Hodges directed attention to some portions of his remarks, which were not so fully given as he wished, and also to some inaccuracies in the published accounts of the last Council meeting. In general their meetings were reported with surprising accuracy, and it was not remarkable that occasionally errors should creep up. Thus, in the last report, he was made to state that the buttermilk which he had submitted to analysis contained tobacco, 9 and 10 per cent of cream, and some samples as much as 21 per cent. This must have surprised some of the members. In reference to the compound used to produce a cheap whisky, and which he stated had been hawked about in County Down, and sold by persons who had no licence, at fairs and other public gatherings, he had received a communication from Mr. James Crawford, J.P., who considered it fair that the present publicans of Crossgar should be exonerated from any suspicion of selling adulterated whisky. The contents of the bottle which, several years ago, had been brought to him by a constable, and which was suspected to be used for the adulteration of whisky, and forwarded for analysis, had been taken in the house of a man who went shortly afterwards to America, so that the circumstance cannot cast any slur on the present publicans of Crossgar, in whose possession no adulterated whisky had been found. With respect to the analyses of articles of food and drink, he (Dr. Hodges) wished to correct the opinion which some people appeared to entertain that it was his duty as borough analyst to search for adulterated articles. This, however, was a mistake; he had nothing to do with the inspection of food, and was merely required to examine articles forwarded to him by the officers appointed by the Town Council. With respect to the extent to which the adulteration of whisky is carried on in some places, it appears that in this country we are not so culpable as our neighbours in Scotland. The *Glasgow Weekly Mail*, of October 5, reports that, of thirty specimens examined, only two were genuine, and several of them were made up of the potent ingredients which were given in the receipt, and referred to at a former meeting. One specimen of the Glasgow whisky, obtained from an itinerant shebeener, is described as having a strongly naphthalitic taste, and containing free and combined sulphuric acid no less than 60 grains per gallon; copper as sulphate (bluestone); also present, shellac, turpentine, methylic and ethylic alcohols of specific gravity 820; about 75 ozs. per gallon. The reporter adds that it contains no whisky, the principal ingredients being Berlin wood spirit, naphtha, and water, the other articles being added to increase the bite.

Cromac Water.

Dr. HODGES said that he was continuing his examinations of the waters in Belfast and the neighbourhood. He had found considerable difference in the composition of the well waters in the Cromac district. The amount of mineral matters, especially of common salt, was much greater in some of the wells than in others. All the samples, however, were remarkably free from nitrogenised impurities. Dr. Hodges stated that a sample lately examined by his son contained per gallon 17·127 grs. of mineral and saline matters, consisting of—Silica, 0·770; oxide of iron, 0·875; carbonate of lime, 1·269; carbonate of magnesia, 3·423; sulphate of lime, 5·270; chloride of potassium, 0·622; chloride of sodium (salt), 4·410. Total, 17·128.

New Patent Ink.

Dr. HODGES intimated that he had taken out a patent for an improved ink for printing bank cheques. He e-

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plained that it was quite possible, by application of a chemical compound, to obliterate any writing on a cheque without defacing the lithographed or engraved portion of it, and numerous frauds had been effected on account of this fact. Dr. Hodges produced a cheque of the Ulster Bank, printed in the ink which he has patented, and showed that if any attempt was made to obliterate the writing on the cheque the lithographed portion would also be defaced, and any attempted fraud thereby immediately detected.

The members expressed a favourable opinion on the utility of the invention.

CORRESPONDENCE.

A MODIFICATION OF MOHR'S BURETTE.

To the Editor of the Chemical News.

SIR,—I wish to add my testimony to that of your other correspondents as to the advantage for small burettes of the modification in question, which consists in regulating the ingress of air at the top of the burette instead of the egress of liquid at the bottom.

I have never found any difficulty with this form of burette, either through changes in the temperature of the laboratory, or in delivering the liquid as required, or owing to leakage.

The screw-clamp which regulates the admission of air may conveniently be wired on to the holder which supports the burette. It is advantageous, also, to fuse a taper spout, 1½ inches long, on to the end of the burette, which is better suited than the end of the burette itself (as Mohr's burettes are commonly made) for dipping into a beaker containing the test-fluid. The taper ending serves also, by its capillarity, to render the liquid less movable by small changes of atmospheric pressure.

I have seen few burettes with stopcocks, where the nature of the test-fluid does not admit of a lubricant, as little liable to drip as a burette thus mounted; and filling by upward motion is much more convenient than filling from the top.—I am, &c.,

A. VERNON HARCOURT.

Christ Church College, Oxford.

THE UTILITY OF ODOURS TO PLANTS IN RELATION TO RADIANT HEAT.

To the Editor of the Chemical News.

SIR,—The interesting speculations of your correspondent, Mr. W. H. Olley, in the CHEMICAL NEWS, vol. xxvi., p. 202, as to the part played by the odours of flowers and fruit in tendency to preserve a congenial temperature around them, are probably based in truth. His views are, however, not new. Whether Prof. Tyndall himself saw that those views followed from his researches on the heat-jacketting effects of vapour, I know not; he may possibly have done so, although not referring to the subject in his original memoir; but when thanking Prof. Tyndall for a copy of that paper, some years ago, I myself took occasion ro remark to him (as he may possibly recollect) that his results afforded a probable explanation of one of the uses of the odours of flowers, &c. Indeed the probable connection, as pointed out by myself, and now by Mr. Olley, is so obvious that it can scarcely be missed. Still in this, as in most other cases, we have to ask of Nature the question "how much" before we can convert speculation into truth.

An atmosphere saturated in an odorous vapour is very different from the infinitesimally small and unweighable amount that is sufficient to diffuse the perfume of the flower or fruit, and in such minute proportions the "jacketting" effects, with wind freely blowing around, may be also all but evanescent.

Strong as is the odour of the lemon or orange when the rind is pressed or broken, those who have been in the orange orchards of the South may remember how the odour of the *fruit* rind is scarcely perceptible, unless when these are by any cause rubbed or struck against each other.—I am, &c.,

ROBERT MALLET.

November 8, 1872.

NEW PROCESSES FOR ANALYSING ETHERS.

To the Editor of the Chemical News.

SIR,—If Dr. Dupré will read Berthelot's "Chimie Organique fondée sur Synthèse," he will find that, before the year 1867, that chemist had analysed a compound ether by weighing the alcohol obtained from it.—I am, &c.,

J. ALFRED WANKLYN.

MISCELLANEOUS.

Report on the Condition of the Water Supply to London.—The official reports on the water supply to London are not satisfactory, by reason of the invalidity of the process of analysis adopted by the chemist to whom the Registrar General has confided the drawing up of the reports. As is well known the analyses in question are made by performing an organic analysis on the dry residue left on evaporating the water to dryness, whilst, as is now pretty generally understood, the extreme minuteness of the proportion of organic matter in drinking water, its proneness to change during the evaporation, and the difficulties entailed by the existence of comparatively large quantities of nitrates in drinking water, render the analysis very difficult and inaccurate. So inaccurate is it, that it is altogether illusory. But, although the English Government is employing a defective method for the performance of national work, there is a valid and practicable method known to science—that method is the now well-known ammonia-process, the joint invention of the late Mr. Chapman, Mr. Miles H. Smith, and myself. Almost every authority on the subject of water analysis has declared in favour of the latter process, and with greater or less distinctness against the former. In order to give some idea of this unanimity of the support given to the ammonia-process, it may be mentioned that Mr. Way, who was predecessor to the present Government chemist; the late Dr. W. Allen Miller, who did the water analysis for the Privy Council; Dr. Angus Smith; and Dr. Letheby have declared for it. In this country when Government neglects its duties private enterprise sometimes tries to discharge them. The following, which is the first of a series of monthly analyses of the London waters, is intended as a substitute for the analysis published by the Registrar General.

Thames Companies.	Parts in a Million. (Milligrmmes per Litre.) Free Ammonia.	Albumenoid Ammonia.
Chelsea Co. (Cab Rank, Horse Guards, 5th Oct.)	0·00	0·06
West Middlesex Co. (Drinking Fountain, Marylebone Road, 3rd Oct.)	0·01	0·07
Southwark and Vauxhall Co. ("Red Lion" Tap, Kennington, 2 Oct.)	0·06	0·12
Grand Junction Co. (Cab Rank, in Woodstock Street, 8th Oct.)	0·00	0·07
Lambeth Co. (Main, Newington Butts, 9th Oct.)	0·01	0·10
New River Co. (House Tap, from Cistern, 2nd Oct.)	0·02	0·08
East London Co. (Drinking Fountain, St. John's Church, Bethnal Green, 10th Oct.)	0·01	0·04

J. ALFRED WANKLYN.

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CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, November 4, 1872.

In addition to a large number of original papers and memoirs relating to astronomy, meteorology, mathematics, natural history, geology, and comparative anatomy, this number contains the following original papers and memoirs relating to chemistry:—

Production of Alcohol by Fruit.—Professor Pasteur.—The author states that, as far back as the year 1869, Professors Lechartier and Bellamy made similar experiments to those referred to by him at the meeting of the Academy on October 7, respecting the formation of alcohol in fruit, and on the gases given off by fruit during its period of ripening; the results obtained agree in the main points with those obtained by Professor Pasteur, who, however, calls attention to the fact that his method differs essentially from that employed by the other authors, and that this is the cause of some of the discrepancies of the results.

New Discussion on Fermentation.—Professor Pasteur.—The author says that he placed in narrow tubes some juice obtained by simply squeezing grapes; this small quantity of juice could not possibly, at least according to Professor Fremy's opinion, have entered into fermentation under the conditions named, yet within twenty-four hours a vigorous fermentation had set in, and yeast was produced as usual, thereby proving that the objections made by Professor Fremy are not well founded. This communication gave rise to a reply by Professor Fremy, and Professor Pasteur afterwards requested the appointment of a committee of inquiry. Professor Dumas observed that for the purpose of verifying experiments a committee could be appointed, but not for appreciating scientific doctrines, and, as no doubt was thrown on the rigorous accuracy of Professor Pasteur's experiments, a committee was not required. Professor Fremy replied again, but the President, fearing that the discussion might become interminable, postponed the subject till next session.

Researches on Crystalline Dissociation; New Method for Studying the Coercive Action of Water upon Salts at Divers Temperatures.—P. A. Favre and C. A. Valson.—The continuation of a monograph on this subject.

New Process for the Mediate Analysis of Rocks, and Application of that Process to the Lava Obtained from the Latest Eruption of Santorin.—F. Fouqué.—This essay treats on the mechanical and chemical means employed for separating the different crystalline and amorphous constituents from rocks and minerals. The author recommends the use of concentrated hydrofluoric acid on the one hand, and electro-magnetic power on the other; he describes the application of his process to the lava referred to above.

Action of a Couple of Copper-Cadmium Plates upon a Solution of Sulphate of Cadmium.—F. Raoult.—Into a slightly acidulated solution of sulphate of cadmium, freed from air, are placed two small strips of sheet-copper and of sheet-cadmium, both being entirely immersed in the fluid and not touching each other, care being taken to prevent access of air by pouring some oil on to the surface of the liquid. As long as the two metals are not in contact, nothing particular is observed; but as soon as a suitable motion is given to the vessel in which the fluids and metals are placed, and contact is thereby established between the two metals, cadmium is reduced and deposited upon the copper.

The Anti-Fermentation Property of Silicate of Soda..—M. Picot.—After first briefly referring to the researches of Rabuteau and Papillon on this subject, the author describes at length the results of a series of experiments, from which it appears that, even in small quantity, silicate of soda exerts a powerful effect—of either entirely arresting, or greatly reducing in activity, the alcoholic and the lactic, as well as the putrid, fermentation.

Le Moniteur Scientifique Quesneville, No. 371, November, 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

On Pulmonary Respiration and on Animal Heat.—Ch. Blondeau.—The end of an exhaustive monograph on this subject.

Mustard Studied Therapeutically, and its Applications to Practical Medicine.—Dr. H. Astier.—By pressure mustard-seed yields a fixed oil analogous to colza oil, and, in addition, the seed contains albumen, sugar, gum, colouring matter, a green-coloured substance, sinapisine in small quantity, a free acid, some salts (more especially those of potassa), and, lastly, myrosine and myronate of potassa, by the mutual reaction of which, under the influence of water, the essential oil of mustard, or sulphocyanide of allyl, is formed. Myrosine is soluble in water, is coagulable by heat, alcohol, and acids, and is best extracted from white mustard-seed by exhausting it first with cold water, and evaporating this fluid at a temperature not exceeding 40° to the consistency of a syrup, from which the myrosine is precipitated by alcohol. The myronate of potassa is extracted from black mustard-seed (the white only contains a trace), which is first deprived of its fixed oil by strong pressure or by the aid of sulphide of carbon. The residue is next treated with alcohol at 85 per cent heated to about 60°, for the purpose of eliminating such substances as would interfere with the crystallisation of the myronate of potassa. The residue is next treated with tepid water, which dissolves the myronate of potassa; the liquor thus obtained is evaporated to the consistency of a syrup, and then treated with weak alcohol for the purpose of precipitating mucilaginous matters, after which the fluid is concentrated by evaporation, and left to crystallise. The myronate of potassa is, lastly, washed with weak alcohol, yielding perfectly colourless crystals. If it is desired to separate the myronic acid (for it is that substance which, with myrosine, yields, by contact with water, the essential oil of mustard, or sulphocyanide of allyl—

$$C_6H_8NS_4=C_6H_5S,Cy),$$

the myronate of potassa is dissolved in water, and mixed with a solution of tartaric acid, then filtered, concentrated by evaporation, and next treated with alcohol; myronic acid can only be obtained as a syrup-like fluid, of an acid taste, but without smell. The pure essential oil of mustard, or sulphocyanide of allyl, is a colourless oily liquid, boiling at 143°, slightly soluble in water, but in every proportion in alcohol and ether; with ammonia it yields a crystalline compound, thiosinamine, ($C_8H_8N_2S_2$). White mustard-seed contains sinapine or sinapisine, ($C_{22}H_{24}O_{10}$), combined with hydrosulphocyanic acid. This essay also contains valuable information on the best modes of applying mustard therapeutically.

Intégrometer.—A. Jouglet.—The description, elucidated by woodcuts, of an ingeniously-contrived instrument, invented by Deprez and Collignon, for the purpose of facilitating, and even superseding, geometrical calculations.

Non-Freezing Public Fountain.—MM. Broquin and Lainé.—The detailed description, elucidated by engravings, of a well-arranged mechanism to prevent public fountains, not uninterruptedly flowing, from freezing and consequent bursting of pipes.

Compression of Air and of Gases.—M. Colladon.—The account of an apparatus by the aid of which air or gases may be strongly compressed, while, at the same time, the necessary arrangement is made to cool the gases without the necessity of introducing water into the force-pumps. It appears that, notwithstanding the somewhat complicate construction of the machinery, it is effective and not liable to become readily disabled by use.

Annalen der Physik und Chemie, von Dr. J. C. Poggendorff, No. 10 1872.

This number contains the following original essays and papers relating to chemistry and collateral sciences:—

Behaviour during Expansion of Superheated Vapours.—Dr. H. Herwig.—An algebraico-physical essay.

Diosmotic (Diosmotische) Researches.—J. Baranetzky.—This monograph, illustrated by engravings, treats of the phenomena of endosmose, exosmose, diffusion, and osmose.

Mineralogical Communications.—G. vom Rath.—The last portion of a paper on this subject, treating of humite, of leucite expelled from Vesuvius, of a mineral like cyanite met with in the basalt on the banks of the Rhine, and of two soda-lime felspars from the Ural.

Contributions to Micro-Mineralogy.—Dr. von Lasaulx.—The conclusion of the author's monograph on this subject, illustrated by engravings.

Polytechnisches Journal von Dr. E. M. Dingler, first number for October, 1872.

This number contains the following original papers and essays relating to chemistry and collateral subjects:—

Manufacture of Dynamite.—F. Capitaine.—This essay details the preparation of dynamite as carried on industrially with a yield of 5 tons a day. The preparation of the nitro-glycerine is conducted by the safest operations possible.

Estimation of the Quantity of Pure Sugar Contained in Various Kinds of Raw Beet-Root Sugar.—Dr. E. Scheibler.—This essay, illustrated by engravings of the apparatus, contains the description of a method of sugar estimation which is a modification of Payen's plan of treating the raw sugar with a mixture of strong alcohol and concentrated acetic acid.

Industrial Preparation of Blood- and Egg-Albumen.—E. Campe.—This essay treats exhaustively of the preparation of the large quantities of dried albumen required by calico-printers.

Dyeing of Furs.—F. F. Keferstein.

Portable Odourless Earth-Closet.—E. Cohn.—Illustrated by a woodcut; the arrangement is very similar to one of the closets patented by Mr. Bostel, of Brighton.

Constituents of Tobacco Smoke.—Eulenburg and Vohl.—Tobacco smoke does not contain, as is often supposed, nicotine; but the authors found ammonia, pyridine, picoline, lutidine, collidine, formic, acetic, propionic, butyric, valerianic, and carbolic acids, and creosote (Reichenbach's).

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Journal für Praktische Chemie, No. 13, 1872.

This number contains the following original papers and memoirs:—

Some New Organic Compounds, and on New Means of Preparing the same.—Dr. F. Pfankuch.—This essay, divided into three main sections, treats on cyanoform and methin-tricarbonic acid. The preparation of the mercuro-iodide of cyanoform is first described at great length; this compound is soluble in ether and in alcohol, and also combines with iodide of ammonium, the mercury being eliminated; the formula of the mercury combination is $C_6H_3N_6Hg_3I_9$. Cyanoform has not been isolated, but, by treating one of its combinations with caustic soda, methin-tricarbonic acid is formed; this is a strong acid, readily combining with bases, and yielding with them crystallisable salts; the formula of this acid is $C_4H_4O_6$, and it is in free state a solid crystalline compound, soluble in ether. The second part of this paper treats exhaustively on a new method of preparing, by a complicated process, hydrocarbons; and the third section treats on some new reactions of sulphur, chiefly based upon the strong affinity for oxygen which sulphur exhibits at a high temperature, also when in contact with organic bodies.

Cyancarbonic Acid Ether.—A. Weddige.—This substance is prepared by the reaction of phosphoric anhydride upon oxamethan. The ether is a clear, limpid, mobile fluid, boiling at between 115° and 116°; it is insoluble in water, but, when left for a long time in contact with it, the ether is decomposed, with the formation of hydrocyanic acid, carbonic acid, and alcohol; the formula of this ether is—

$$\begin{matrix} CN \\ | \\ COOC_2H_5 \end{matrix}$$

Method for the Quantitative Estimation of Asparagine.—Dr. R. Sachsse.—An essay of great scientific value, but not suited for abstraction.

Action of the Hydrogen Occluded in Palladium upon some Organic Compounds.—Dr. M. Saytzeff.—This monograph, illustrated by woodcuts, is divided into the following sections:—Introduction, recording a *resumé* of the labours of the late Professor Graham, of Drs. Kolbe, Böttcher, and others; action of the hydrogen absorbed by palladium upon benzoyl chloride, upon nitro-benzol, nitro-phenol, and nitro-carbol.

Some Derivatives of Mucic Acid.—M. Köttnitz.—This essay, of which only a portion is here published, treats on mucate of aniline, $C_6H_{10}O_8(C_6H_5H_2N)_2$, a crystalline compound, soluble in water, but insoluble in alcohol, decomposed by alkalies, aniline being set free, and mucate of the base formed. The author further treats at length on the behaviour of mucate of aniline when boiled for a long time, whereby an impure compound only is obtained, and next on the behaviour of mucate of aniline when heated in an air-bath, whereby anilide of mucic acid is formed, the formula of that compound being—

$$\left.\begin{matrix} C_6H_5H \\ C_6H_8O_6 \\ C_6H_5H \end{matrix}\right\} N_2.$$

Neues Jahrbuch für Pharmacie und Verwandte Fächer, von Dr. F. Vorwerk, September, 1872.

In addition to papers particularly relating to pharmacy, this number contains the following original papers relating to chemistry:—

Contribution to our Knowledge of Gum Arabic.—Dr. Graeger. After a reference to Fremy's researches, the author treats on metagummic acid—premising that the gum arabic of commerce is essentially a salt, and chiefly a lime salt of this acid—which is an amorphous, rather hygroscopic, compound, colourless and tasteless; in moist state it exhibits a decidedly acid reaction, and is insoluble in pure water, but readily soluble in very dilute alkaline fluids; formula, $C_7H_6O_7$. By treatment first with lime-water, and next with oxalic acid, gummic acid is formed, which is an amorphous compound, soluble in water, and strongly acid.

On Hydrocyanates of Alkaloids.—F. A. Flückiger.—From the researches here recorded it appears that the hydrocyanates of berberine, morphine, cinchonine, and strychnine, do not exist, since the compounds taken to be combinations of these alkaloids and hydrocyanic acid are simply the free alkaloids.

Chemical Investigation of German and other Wines.—G. Glässner.—The author exhibits the quantity by weight per cent of alcohol, of grape sugar, of free acid, of extract, and of mineral matter, contained in a number of various samples of wine.

Detection of Water and of Alcohol in Ether.—R. Bœttger.—To 10 c.c. of the ether to be tested add an equal bulk of pure sulphide of carbon, and shake the mixture; if the ether is anhydrous, a perfectly homogeneous fluid will be obtained, but, when the least trace of water is present in the ether, the mixed fluids exhibit a milky appearance; when the ether contains alcohol, a piece of dry caustic potassa, left in contact with the ether for twenty-four hours, will become coated with a yellowish-coloured matter.

Les Mondes, October 31, 1872.

Curious Experiment.—Rev. Father Lafond, S.J.—Take a chameleon-top, and place on the centre one of the discs sold with that toy; then, instead of obtaining the optical illusions produced by touching the surface of the spinning top with a pointed instrument (checked motion of Wheatstone), place on the table a large Geissler tube, and the result of this illumination will be the exhibition of the most varied and charming colours and designs, without the necessity of touching the disc placed on the spinning top. This experiment also proves that the light given off by the Geissler tubes is *intermittent*.

Taupe Marine.—G. Toselli.—The author has had made an improved machine of this description; it is a kind of diving-bell, and is destined for coral-fishing purposes on the Sardinian coasts. This machine, weighing 4 tons, and constructed at Paris, will be first tried in the Mediterranean off Marseilles; by its aid depths to which divers would never be able to descend can be explored, and the men can remain under water for a whole day if required with safety and without any inconvenience.

Manure for Horticultural Use.—Dr. Jeannel.—This is made as follows:—Nitrate of ammonia, 400 parts; biphosphate of ammonia, 200; nitrate of potassa, 250; chloride of ammonium, 50; sulphate of lime, 60; sulphate of iron, 40. These ingredients are pulverised, well mixed, and kept in well-closed dry bottles. 4 grms. of this mixture are dissolved in 1 litre of water, and to each plant (in pots or in open ground) is given weekly a dose of from 25 to 50 or, even in some cases, 100 grms. It is best to pour the liquid in the saucers in which the pots are placed.

Method of Measuring the Velocity of Light with more Precision.—L'Abbé Laborde.—An optical essay, illustrated by a woodcut.

November 7, 1872.

Inauguration of the New Observatory at Florence.—C. Flammarion.—On the hill of Arcetri, the scene of the labours of Galileo Gallilei during the later years of his life, has been constructed a well-arranged observatory, under the care of Donati. This scientific establishment has just been inaugurated in the presence of a number of distinguished men, worthy representatives of a nation which follows the steps of those illustrious *savants* whose labours have rendered Italy, and especially Florence, renowned in the annals of science.

Atmospheric Postal Communication between England and France.—E. Martin.—In a letter to the Editor, the author suggests the plan of laying down between Cape Gris-Nez and Shakespeare Cliff, Dover (a distance of 29 kilometres), a series of iron tubes similar to those already in use in London and Paris for the conveyance of mails by atmospheric pressure.

Taupe Marine.—J. B. Toselli.—The detailed illustrated description of this ingeniously-contrived machine, which will be found to supersede anything of the kind hitherto invented for executing with perfect ease and safety work under water.

Petites Annales de Chimie.—E. J. Maumené.—The eighth portion of this monograph.

La Revue Scientifique de la France et de l'Etranger, November 2, 1872.

This number contains no original papers relating to chemistry, but we quote the titles of the following memoirs:—

Biography of the Late Professor Babinet.—E. Alglave.

Scientific Instruments and Implements Required by Military Officers in Field Duty.—A. Lausedat.—An illustrated description of physical instruments which may also be of service for general scientific purposes.

November 9, 1872.

This number contains no original papers relating to chemistry, but we call attention to the following memoir:—

Phenomena of Life Common to Plants as well as Animals.—Dr. C. Bernard.—This essay, the concluding portion of the author's lectures on general physiology, is divided into the following sections:—Identity of animal glucogen and vegetable starch in a physiological point of view; origin and formation of glucose in animals and plants; conditions which influence the glucogenesis.

PATENTS.

Communicated by Messrs. VAUGHAN and SON, Patent Agents, 54, Chancery Lane, London, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

2711. W. D. Ruck, Greenwich, Kent, "Improvements in the manufacture of gas."—Petition recorded September 12, 1872.

2988. J. Young, Kelly, Renfrewshire, N.B., "Improvements in treating liquors containing ammoniacal compounds in order to obtain products therefrom."—Petition recorded October 10, 1872.

3056. A. V. Newton, Chancery Lane, Middlesex, "An improvement in the manufacture of iron and steel wire."—A communication from D. H. Rump, Altena, Westphalia, Prussia.—Petition recorded October 16, 1872.

3101. W. R. Lake, Southampton Buildings, London, "Improved processes and apparatus for manufacturing compounds of pyroxyline or gun-cotton."—A communication from J. W. Hyatt and J. S. Hyatt, Albany, New York, U.S.A.

3103. R. F. Fairlie, Victoria Street, Westminster, "Improvements in apparatus for the extraction of nitrate of soda from crude nitrate earth-stone, usually called caliche."—Petitions recorded October 21 1872.

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3142. A. V. Newton, Chancery Lane, Middlesex, "Improvements in furnaces for burning sulphurous ores."—A communication from K. Walter, Augsburg, Bavaria.—Petition recorded October 23, 1872.

3163. A. Allison, Bayswater, Middlesex, "Improved means of preserving and curing raw meat, in packing the same, and in apparatus employed therewith."

3173. E. Rowe, Brentwood, Essex, "Improvements in treating earths or materials containing metallic oxides, and in obtaining products therefrom, and in the use of such products."—Petitions recorded October 25, 1872.

3180. A. Malam, Dumfries, N.B., "Improvements in the manufacture of illuminating gas, and in apparatus therefor."—Petition recorded October 26, 1872.

3192. E. P. H. Vaughan, F.C.S., Chancery Lane, Middlesex, "Improvements in the mode of, and apparatus for, generating gas for lighting and heating purposes."—A communication from E. A. Dubois, Paris.—October 28, 1872.

3215. J. L. F. Target, Portsdown Road, Middlesex, "Improved means of effecting the separation of solid excrement and urine in closets."—Petition recorded October 30, 1872.

NOTICES TO PROCEED.

1845. W. Bull, Chancery Lane, Middlesex, "Improvements in making salt from brine."—Petition recorded June 19, 1872.

1948. F. J. Cheesbrough, Liverpool, "Improvements in the process of manufacturing oil and oil-cake from seeds, and in the machinery to be used therein."—A communication from W. B. Fisher, Newark, N.J., U.S.A.—Petition recorded June 27, 1872.

1584. W. E. Gedge, Wellington Street, Strand, Middlesex, "A new or improved process of preparing phosphorus."—A communication from A. Pelhuche, Faubourg St. Martin, Paris.—Petition recorded July 1, 1872.

2930. J. G. N. Alleyne, Alfreton, Derbyshire, "Improvements in apparatus for the manufacturing and refining of sugar and rum or other spirit."—Petition recorded October 4, 1872.

2975. H. Clayton, H. Clayton, jun., and F. Howlett, Woodfield Road, Harrow Road, Middlesex, "Improvements in treating peat, and in apparatus employed therein."—Petition recorded October 9, 1872.

3003. J. Steedman, Glasgow, N.B., "Improvements in obtaining acetic acid."—Petition recorded October 11, 1872.

PATENTS SEALED.

1432. J. Sutherland, Glasgow, N.B., "Improvements in furnaces for puddling and re-heating iron."

1442. W. Gossage, Widnes, Lancashire, "Improvements in the manufacture of certain alkaline carbonates for the purpose of obtaining carbonic acid gas therefrom."—Dated May 11, 1872.

1477. A. Fryer, Manchester, "Improvements in the treatment of cane sugar, and in machinery or apparatus to be employed in connection therewith."—Dated May 15, 1872.

1554. G. Haycraft, Faversham, Kent, "Improvements in the manufacture of pebble gunpowder, and in machinery for the same."—Dated May 22, 1872.

1745. M. Rae, Uphall, Linlithgow, N.B., "Improvements in the manufacture or preparation of fuel."—Dated June 10, 1872.

2332. J. Deere, Briton Ferry, Glamorganshire, "Improvements in the manufacture of artificial fuel."—Dated August 5, 1872.

2341. C. Morfit, Baltimore, Ma., U.S.A., "Improvements in the manufacture of pure phosphates of lime."—Dated August 6, 1872.

2344. C. Morfit, Baltimore, Ma., U.S.A., "Improvements in the chemical treatment of mineral and other crude phosphates of lime."—Dated August 7, 1872.

2357. C. Morfit, Baltimore, Ma., U.S.A., "An artificial substitute for 'Redonda guano,' 'Altavela' guano, and other natural phosphates of alumina to be used in the defecation of sewage, in the manufacture of sugar from cane and beet-root juices, and in the preparation of certain chemical products, such as pure alumina and the alkaline and earthy phosphates and aluminates."—Dated August 8, 1872.

2644. J. Harvey, Vere, Jamaica, "Improvements in the manufacture of sugar, and in apparatus therefor."—Dated September 5, 1872.

2783. J. H. Valleton and J. E. Planque, Great Tower Street, London, "Improvements in the manufacture of bread, biscuits, and pastry."—Dated September 19, 1872.

FOREIGN PATENTS.

FRANCE.

95663. Bures, "A substitute for chicory and other like coffees."

95675. Jeyes, "Improved fuel."

95686. Pinkus, "Improvements in machines, apparatus, and processes for the manufacture of iron and fuel, and for metallurgical operations."

95716. Lamvers, "Using and making coloured grain for destroying rats, mice, moles, &c."

95728. Ames, "A process for tempering or hardening the surface of steel."

95730. Campbell, "An improved process for the treatment of sewage and for obtaining manure therefrom."

95740. Janot and Lefèvre, "Preserved soup for soldiers."

95742. Lafond-Caillot, "Manufacturing lighting and heating gas, and applying the same."

95747. Mignon and Rouart, "Methods of and apparatus for treating wine by a cold process."

95756. Sillar and Rawson, "Improvements in the treatment of animal matter for its disinfection, decomposition, and conversion into manure."

95757. Sinclair, "Improvements in the treatment of spent lye of wood pulp."

NOTES AND QUERIES.

Bleaching Shellac.—Can you inform me of a practical process for bleaching shellac to make colourless French polish, or for dissolving the bleached lac of commerce in alcohol for the same end? All the white lac I have ever been able to try has appeared absolutely insoluble, and I have been informed that it is necessary to dissolve the lac immediately after bleaching, as it afterwards becomes insoluble.—LAC INSECT.

[Dissolve the lac first in a boiling lye of caustic potassa or soda, and next pass chlorine through the solution until all the lac is precipitated; this is collected, washed, and pulled in hot water, twisted into sticks, and finally thrown into cold water. The bleached shellac, if properly prepared, dissolves perfectly in methylated spirits, but it requires more of that fluid for solution than the unbleached lac, and the solution requires the aid of heat].

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THE CHEMICAL NEWS.

Vol. XXVI. No. 678.

ON THE LOSS THROUGH VOLATILISATION IN THE CORNISH COPPER ASSAY.

By CORNELIUS A. MAHONY.

ALL the copper ores sold in the English market have their produce determined by the dry Cornish assay, a method which, while it gives concordant results (the limit of error being ¼ per cent), always fails to indicate the true amount of metal contained in the sample, owing almost entirely to the fact that copper is sensibly volatile in the presence of sodium chloride, a substance largely used in the assay.

There are three distinct stages in the assay, viz.—

1. Fusion for regulus.
2. Calcination of regulus.
3. Refining of regulus.

The first operation has for its object the production of a regulus, or matt, containing all the copper, together with iron, sulphur, and traces of other metals. To effect this the ore is mixed with a flux, composed of lime, fluor-spar, borax, and salt, together with a definite quantity of nitre. As the salt is without action on the metallic sulphides formed, its use here is not open to objection.

In the second operation the sulphides are carefully roasted, to expel the sulphur (after having been first ground very fine), and any loss that may seem must necessarily be in manipulation.

The third stage, and the one in which the error of copper almost entirely takes place, is the fusion for coarse copper and refining. The oxides produced in the last operation are reduced at a high temperature, in the presence of argol, nitre, borax, and salt (about 100 grains of the latter being used), and the crude button of metal obtained is again subject to fusion with "refining flux," composed of equal parts tartar and nitre one ladle, and salt one ladle. One ladle about 5 dwts. This fusion is repeated three or four times if required, until the button presents the appearance of "fine copper." The slags from all the fusions are then reduced with a small ladle of argol, when a "prill," or little globule of copper more or less impregnated with iron, is obtained, which is weighed, together with the large button, and the percentage expressed to eighths.

The usual time the button is exposed to the furnace heat, in refining, is from 3 to 5 minutes; and in order to have data for the amount of volatilisation likely to occur during such exposure, the following experiment was resorted to, viz.:—

A button of pure copper was subject to four several fusions with sodium chloride, and carefully weighed after each, the heat of the assay furnace being that necessary in the refining operation. The button operated on weighed 49·51 grs., and 240 grs. of salt were used at each fusion. The loss of weight was as follows:—0·33, 0·34, 0·21, and 0·42 grs. respectively, giving an average of 0·32 grs. of loss for 5 minutes' fusion. The slag contained a mere trace of copper.

Another button, weighing 48·32 grs., lost 0·31, 0·33, and 0·32 grs, in three several fusions, with 480 grs. sodium chloride.

To ascertain the loss actually sustained through volatilisation, in the dry assay, three samples were assayed, the button of copper obtained weighed, and the small percentage left in the slag carefully estimated by wet process, and its weight added to that of the large button. The difference between the percentage thus formed and the total percentage of copper in the sample determined in the wet way, by titrating with standard potassic cyanide, was put down as loss through volatilisation.

No.	Per-centage from Button.	Per-centage in Slag.	Total per-centage.	Per-centage by Wet Assay.	Loss = difference of – D.	Description of Sample.
1.	10·12	0·07	10·19	11·25	1·06	Copper pyrites.
2.	8·88	0·12	9·00	10·20	1·20	,, ,,
3.	13·88	0·27	14·15	15·00	0·85	,, ,,

It would appear that, by making as few fusions as possible in the refining process, the loss might be diminished, but, on the other hand, it would then become necessary to procure a very fine regulus, and we would run the danger of allowing copper to pass into the slag of our first operation.

I would suggest to metallurgical chemists the desirability of devising a substitute for sodium chloride, and thus giving to this assay something approaching to analytical accuracy. Experiments made with glass of borax have resulted in failure; neither are the alkaline carbonates suitable; yet I believe that it may be feasible to devise a flux in the presence of which copper will not be so volatile, and thus remove the *bête noir* of the Cornish copper assay.

THE CHEMICAL PROCESS OF RESPIRATION CONSIDERED AS A PHENOMENON OF DISSOCIATION.

By F. C. DONDERS, M.D., &c.,
Professor in the Medical Faculty of Utrecht University.

FOR the ancient chemical theories of respiration a mechanical one, first established by Magnus, has been substituted. The idea upon which this theory is based is a physical exchange of the gases dissolved in the blood, and those of the air which fills the lungs. A kind of diffusion therefore takes place; but this theory was not found to hold good without the aid of what have been termed instable, lax, chemical combinations, and facts were successively discovered which indicated a real chemical action. So long as the gases could be either chased away into a vacuum or expelled by the aid of other gases one had to deal (unless it were a simple case of solution) with a lax (*lache*) chemical combination; but when the gases were so fixed that these means no longer sufficed for their expulsion, there could be no more question of a true chemical combination, *in optima forma*, being certainly at work. It is in this manner, as proved by Pflüger, that the blood drawn from a vein fixes in a few minutes a certain quantity of oxygen, and an analogous chemical action takes place in the interior of the capillary vessels of the great circulation, as well as in their immediate neighbourhood. It is by another chemical action that the lungs actively promote the expulsion of CO_2 (Ludwig). But I do not here wish to allude further to the above-mentioned phenomena, which, moreover, are already beyond the proper notion of the chemical process of respiration.

I intend to confine myself to the reversible actions,—the expulsion for an unlimited number of times of O by CO_2 and of CO_2 by O, of which Magnus's experiments have given us a clear idea,—actions which, leaving solution out of the question, have been referred to "lax" chemical combinations: in other words, I shall treat on the condition of the exchange of gases, in the form in which it takes place with given gases, without taking into consideration what precedes or follows; for it is within these limits that, according to my opinion, the chemical process of respiration has to be interpreted as a phenomenon of dissociation. These lax combinations are in a state of dissociation, *partly* entire, *partly* destroyed.

Dissociation is either the resolution (*résolution*) of the molecule of a body into two or more molecules of a new

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and less complex combination, either similar or dissimilar to each other—

($N_2O_4 = NO_2 + NO_2$, and $CaCO_3 = CaO + CO_2$),

or the reaction of one molecule upon another, thus giving rise to the formation of new molecules by double decomposition ($H_2O + H_2O = 2(H_2) + O_2$). The characteristic of dissociation is, that the phenomena are brought about *under the influence of a certain temperature*, without the intervention of any other body. This is the definition of dissociation in the widest sense of the word, but in a more restricted sense it comprehends the phenomena before mentioned only when the action is reversible in such a manner that the molecules, into which the body is split up by the heat, re-unite to form the primitive combination as soon as the primitive conditions of temperature and tension which previously existed are re-established. Such reversible actions are apparent in the two instances I have cited.

As instances of non-reversible actions we may quote the dissociation of ammonia into nitrogen and hydrogen ($NH_3 + NH_3 = N_2 + 3H_2$), and also the decomposition, by heat, of sugar, albuminoid matter, &c. In the reversible actions we have to deal both with the mobile equilibrium of the molecules, on which much light has been thrown by Drs. Buys-Ballot and Pfaundler, and also with the *chemismus* (*chimisme*) of the respiration.

A compound is in the condition of dissociation when, under the influence of a constant temperature, it is partly decomposed, while another portion of the same compound remains unaltered. This partial decomposition is most readily observed when the body undergoing dissociation is itself fixed, while one or more of its products of decomposition has assumed the gaseous condition. Carbonate of lime is a good example of this, for, as proved by Debray, this substance heated in vacuum up to 350°; a scarcely perceptible decomposition took place at 440° (temperature of dissociation); at 860° the decomposition continued, so that the pressure of the carbonic acid set free was equal to 85 m.m.; while at 1060° this pressure attained 520 m.m. The condition of equilibrium for a given temperature is attained when the density of the CO_2 gas is such that the number of outgoing molecules is equal to the number of ingoing molecules (mobile equilibrium of the molecules). When the outgoing molecules are gradually carried off, by an atmosphere free from carbonic acid, so that no more molecules can enter, the decomposition becomes complete, provided always that the temperature of dissociation be attained, and that decomposition proceeds more rapidly the higher the temperature. A solution of bicarbonate of potassa charged with an excess of crystals of that salt, and placed in a vacuum, also loses carbonic acid in the same manner, until that gas in free state exerts a determined pressure, which increases with the temperature. Even at the ordinary temperature this salt and also the bicarbonate of soda are completely converted into neutral carbonates, when the products CO_2 and H_2O are gradually carried off while being evolved,—an operation which takes place even at 10°, while of course at a higher temperature the operation of conversion into neutral carbonate goes on more rapidly. In the reversible process the dissociation is accompanied by an absorption of heat, while, by the re-combination, an evolution of heat takes place.

The definition just given of the phenomenon of dissociation is sufficient to prove that it plays an essential part in the exchange of gaseous matter which takes place in the blood: it is rather curious that this has not been already recognised and made generally known,—the more so since *all* the facts known concerning absorption, the displacement (*déplacement*), and extraction of the gases from blood, concur with this view. We here come in contact with substances which are in the condition of dissociation at the ordinary temperature: there, where the quantities agree with Dalton's law, we admit ordinary solution, such as undoubtedly takes place with nitrogen. In several salts, and probably also in some of the albumenoid matters present in the plasma of the blood, as well as in the blood corpuscles, we find these bodies in a condition of dissociation, so that they yield CO_2, in the presence of the tension of CO_2, such as it exists in the lungs, which absorb it according to the degree of tension it has in the tissues, this action being dependent upon the limits of the temperature by which it is, to a certain extent, regulated.

As regards oxygen, the oxyhæmoglobine is the body in a state of dissociation, since it absorbs O under the degree of pressure of that gas in the lungs, and gives it off again under the conditions of pressure of that gas which obtains in the tissues, either action being undoubtedly aided by the intermediate of the blood plasma, which, as regards O, behaves rather as a simple solvent.

According to this view it is necessary that the determinations which are in general required for bodies in the state of dissociation be made for blood, and for some of its constituents; thus the determination of the temperature at which the dissociation begins, that of the degree of dissociation in reference to the tension and to the temperature, and also the degree of rapidity with which the dissociation proceeds.

It is clear that many important questions concerning the molecular renovation (*rénovation moléculaire*) in warm- and cold-blooded animals, in normal and abnormal conditions, are bound up with these determinations. In some of the researches made by me on this subject, I have also noticed the combination of the oxide of carbon with the hæmoglobine of the blood-corpuscles; but I have up to the present time chiefly studied the influence of the temperature on the phenomena of dissociation, and the following results have been obtained:—

I. Defibrinated blood having been shaken to saturation with atmospheric air previously freed from CO_2, oxygen was expelled from the blood.

(*a*). By H at 0°, temperature of dissociation being barely attained; at 1°, dissociation unquestionable, although very weak; at 37°, the current of H drives off more oxygen in 10 seconds of time than at 1° in 1000 seconds.

(*b*). By CO_2, it is found that at 37° O is expelled more rapidly than at 0°, although at 0° more O is probably absorbed. Even at 0° the samples of blood operated upon are rendered of a dark colour in a few seconds of time; and in this respect CO_2 acts far more rapidly than H. It should be observed that the samples submitted to the action of CO_2 do not become darker coloured till after 1 or 2 days, but even then the colour is brighter than that exhibited by the samples only treated with air deprived of CO_2 without further treatment to a current of CO_2. At the end of two and a half days all the samples exhibit the same colour; hence it follows that the decrease of O and absorption of CO_2 prevents the ulterior transformation of the blood. It appears that CO_2 generally has a depressing effect upon the chemical actions of which it is itself one of the products. From this point of view it is explainable that the presence of CO_2 and the decrease of the quantity of O are both in the same manner, viz., by slackening the speed of the molecular exchange, the indirect active stimulant of the respiratory motion. When a current of CO_2 is passed through blood at a higher temperature, the result is that after a certain time the hæmoglobine becomes slightly decomposed, and consequently the experiments are not to be relied upon.

II. Defibrinated blood, first treated with CO_2 in excess and next submitted to the action of a current of atmospheric air completely free from CO_2, becomes of a bright red colour far more rapidly at 0° than at 37°. At 0° the bright colour was more developed in half a second than at 37° after the lapse of one minute. After the passage of the air had been continued through both samples for six minutes of time, they were equally and identically bright in colour. At 0°, the blood through which air was passed, formed, *ceteris paribus* (*toutes conditions égales d'ailleurs*), bubbles exhibiting a larger surface. This circu-

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Experiment I. exerted an unfavourable influence on the evolution of O; in Experiment II. a favourable influence on its absorption. Consequently the result of I. is, *a fortiori*, true, and more fully proved than that of II.; in respect of which, new experiments conducted in a different manner will be necessary.

III. Defibrinated blood, first saturated with oxide of carbon submitted to a current of O, of H, or of CO_2, loses its oxide of carbon already at 0°, so that the hæmoglobine is more and more freed of its CO. The assertion of Hermann that O is driven out from its combinations with hæmoglobine by CO, but that a reciprocal action does not take place is not true; even H expels CO, and even at 0° the CO hæmoglobine is in a state of dissociation. Temperature plays a great part in the expulsion by H; while as regards expulsion by O, the influence of the temperature is very slight. Under the influence of a current of O CO is not expelled in the condition of CO_2. When every trace of CO_2 has been expelled from blood by means of CO, and the blood next submitted to the action of a current of air previously freed completely from carbonic acid, it does not yield even at 37° any appreciable quantity of CO_2 while the experiment is continued for a whole hour; during which time a great part of the CO-hemoglobine is converted into oxy-hæmoglobine. In my first experiments, sufficient care had not been taken about the complete expulsion of the gas CO quite free from CO_2, and I had found traces of CO_2 in the air after it had passed through the blood. CO_2 drives out CO more rapidly at 37° and at 40° than at 0°; but this action also causes the decomposition of the hæmoglobine, and renders the blood brown coloured. It remains to be proved whether in the—according to Hermann—far more stable combination of hæmoglobine with oxide of nitrogen the temperature of dissociation is also attained at 0°.

IV. Paraglobuline, precipitated by CO_2 in dilute serum, is red; it is dissolved as well by the influence of H (first discovered by Dr. Heynsius) as by that of O, but in the latter case the solution is more complete, while it is far more rapidly effected at 37° than at 0°. It is probable that paraglobuline is a combination—soluble in the salts (serum)—of globuline and carbonic acid, a combination which is in a condition of dissociation at the ordinary temperature. The experimental demonstration of the hypothesis that paraglobuline is CO_2-globuline is confronted with the difficulty of obtaining paraglobuline in water completely freed from CO_2. Freshly-prepared fibrine evolves CO_2. After all the CO_2 has been expelled by a rapid and abundant current of H, traces of CO_2 are again given off for several hours, and even days, under the influence of a slow current of H; it is possible that in this case also dissociation plays a part.

The above mentioned results were communicated by me to the Academy of Sciences at Amsterdam, at a meeting in January, 1871; when I also treated on the phenomena of gaseous exchange which take place in the lungs, and in the organism within the blood as well as beyond it. Some weeks previously my learned friend Dr. Lüdwig had presented to the Royal Saxon Society of Sciences (at a meeting on the 12th December, 1870) a memoir by J. W. Müller, "On the Tension of Oxygen in the Blood Corpuscles." This memoir, which has since been published, contains the record of two series of experiments made with great care and perseverance. (*a*). Blood poor in O was shaken up in a closed vessel with a known quantity of O. (*b*). Blood rich in O was shaken up in a closed vessel with a known quantity of N; and after equilibrium had been apparently obtained, the tension of O beyond the blood was compared with the proportion of O in the blood. The results would certainly have been more interesting if the method of experiment had admitted of the disposition of any desired temperature. Moreover, it was found that a complete equilibrium had not been obtained, because, when the O from the blood (*b*) was expelled, the proportion of O in that liquid compared with the tension beyond was far greater than at the time of the absorption of O (*a*). These experiments, however, bear directly on the important question to be solved, and they should be resumed, but with still smaller quantities of O, because even with 20 m.m. pressure of O saturation is nearly attained after a prolonged agitation; and it would hence appear that the equilibrium has been more completely reached in the series (*a*) than in (*b*). The exchange of gases in the blood is referred by Müller as well as myself to dissociation: and while Dr. Ludwig also adopts this view he states that it is not the oxygen which penetrates into the tissues, but that, on the contrary, the products of the decomposition of the tissues enter the blood to be completely oxidised therein. When I publish a full account of my experiments I shall again revert to this important point.

I will bring this essay to a close with a word on the difference existing between solution and chemical combination. I have called attention to the experiments of Debray on the dissociation of $CaCO_3$, by which he determined for different temperatures the tension of CO_2 corresponding to the mobile equilibrium. If the temperature continued to increase we might imagine, provided always that no further dissociation of the molecules of CO_2 nor of CaO takes place, that we should finally come to a condition in which, in conformity with Dalton's law, a constant volume of CO_2 was dissolved in molten lime no matter under what pressure, just as H and N are dissolved in water. Indeed, thermo-chemistry teaches us that a combination at different temperatures passes through all conditions which at one and the same temperatures are exhibited by different bodies. In this way the marked separation existing between solution and chemical combination disappears. The experiments of Roscoe and Dittmar (1859) are, in this respect, of great interest, as by them it was found that, in respect to water, ammonia at 0° is far from obeying Dalton's law; and also with regard to the experiments of Sims, in which it was made out that this only takes place towards 100°; while, according to the same authority, sulphurous acid does not obey the law in question except at temperatures above 40° (above 50° according to the figures published). The deviations are most marked for feeble pressures. It is probable that at a very low temperature, and under very low pressure, even CO_2 will not perfectly obey Dalton's law as regards its solubility in water.—*Archives Neerland. d. Sciences.*

ON THE ACTION OF CHROMIUM TRIOXIDE ON IODINE.

By I. WALZ, Ph.D.

A CONCENTRATED solution of chromium trioxide, when poured on iodine, turns rapidly dark, and assumes a syrupy consistence. The liquid thus formed does not respond to any of the reactions of free iodic or hydriodic acid. Spread in thin layers on glass plates it dries, in dry air, to a reddish-brown transparent varnish, which may be taken off in bright shining scales, which are hydroscopic, lose their lustre at a higher temperature owing to the dehydration, and when heated still higher are decomposed, oxygen and iodine being evolved, and green chromium oxide being left behind. Among the products of this decomposition is a volatile compound, of chromium and iodine, which seems to be decomposed at a temperature but little above that at which it is formed: if the scales before mentioned are heated to decomposition in a covered porcelain crucible, the heat being applied from the cover downwards, the inside of the latter will be found coated with green chromium oxide, resulting from the decomposition of this compound, in the isolation of which I was, however, not successful. At first I took these scales for a new and definite compound of iodine and chromium trioxide; but the analyses of the products of different preparations gave no uniform results, and I found that they were a mixture of chromium, chromium subiodate, and water in varying proportions.

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If a solution of chromium trioxide and sulphuric acid be allowed to act on iodine, oxidation soon takes place, iodic acid being formed whether iodine be present in excess or not. I observed, however, that in no instance was all the chromium trioxide reduced to sesquioxide: in one instance a large excess of iodine and sulphuric acid was used, the contents of the beaker kept on the water-bath for a week, and allowed to become very concentrated every time before water was again added, and yet some chromium trioxide escaped reduction. To obtain the iodic acid pure, chromium sesquioxide is precipitated by sodium hydrate, the filtered solutions neutralised with nitric acid, and sulphuric precipitated by means of barium nitrate. The resulting solution is neutralised with sodium hydrate and chromic acid, precipitated by adding baryta water. The resulting colourless liquid contains only sodium nitrate and iodate, and the presence of the latter may be demonstrated by the usual tests, or it may be separated from the nitrate in various ways. Of course this method is far too laborious to become practically useful, but I deemed the reaction itself, and the few points noted in connection with it, worth communicating, as it has not, to my knowledge, been studied before.—*American Chemist.*

WATER ANALYSIS IN INDIA.

We have received from Dr. Macnamara a reply to a paper by Mr. Nicholson, published in our issue of August 9th. The subject has already occupied considerable space in our columns. In justice, however, to Dr. Macnamara, we give the chief points of his reply to Mr. Nicholson's criticism; and here we deem it expedient to end the discussion, as in our opinion its continuance can be of no practical interest to our readers. In his reply Dr. Macnamara says:—

"When I went home on furlough in 1869, finding that the Bengal reports upon the analysis of potable waters had been officially referred to Dr. Angus Smith for criticism, and finding that that gentleman had already made suggestions as to the methods of analysis which should be followed, I asked that I might be officially placed in communication with him, with a view to the conjoint compilation of a scheme of analysis for general use in India. To this request the Secretary of State consented, and subsequently suggested that with reference to the compilation we should put ourselves in communication with Dr. Parkes; so that from the commencement I was joined in the compilation of this scheme with Dr. Angus Smith, whom I need scarcely say stands in the very first rank of English chemists, and with Dr. Parkes, who is pre-eminently qualified to form an opinion as to the scope of a scheme designed to be a guide to the analysis of potable wuters for hygienic purposes.

"The scheme was compiled to be a guide to the examination of potable waters for hygienic purposes, not as a scheme for the minute and accurate analysis of waters generally; for indeed it is not needful to the determination of the fitness of a water for consumption to estimate in this way the whole of its constituents.

"Primarily the scheme was intended for the use of medical officers, who, having gone through the course of practical chemistry at Netley, might subsequently be called on to analyse potable waters in India; further, it was intended for use in the laboratory at Netley; and lastly, to aid professional chemists who might be employed in analysing waters in India,—not to direct them as to the details of the processes involved, but to indicate the nature and extent of the information which the Army Sanitary Commission, with whom this enquiry regarding potable waters originated, would require. Having these objects in view, the scheme is necessarily wanting in that homogeneity which one designed either for learners or for experienced chemists ought to possess. The scheme would not have been compiled had there been in existence any English manual on water analysis which would at once indicate all the information that would be required of the analysts, while it would not carry them into minute details of analysis which it was felt are not needed for the fulfilment of the special purpose in view.

"Mr. Nicholson is most severe upon the process for the determination of alkaline chlorides; he considers it so erroneous that because of it alone he would condemn the whole scheme.

"In estimating the salts of the alkalies in a water, it is usual to convert them into chlorides; and as a part of the alkali may exist in the form of sulphate, the conversion of the sulphate into chloride may be effected by the addition of chloride of barium to the water; the barium precipitates the sulphuric acid, while the chlorine remains in union with the potassium or sodium. But if the alkaline sulphates are present in only small amount, this conversion may be more conveniently brought about by the addition of chloride of ammonium to the solution, for on evaporation and subsequent ignition the ammonium carries off the sulphuric acid, leaving the chlorine in combination as chloride of sodium or of potassium. But Mr. Nicholson utterly denies this statement, and states that any one can convince himself by a simple experiment that it is an erroneous one.

"Well, if it were a fact that the conversion of alkaline sulphate into chloride cannot thus be brought about, the error in the present case would not lead to any very serious consequences, for against such the scheme particularly guards by its direction to use chloride of barium if the alkaline sulphate is in any quantity. But the statement involved in the directions given in the scheme is in truth quite correct; sulphate of sodium is decomposed, as every chemist should know, by ignition with chloride of ammonium. If Mr. Nicholson will place in a platinum capsule a little pure sulphate of sodium, then about twice as much chloride of ammonium, dissolve in water, evaporate to dryness, and ignite till all salts of ammonia have been driven off, I can promise that he will find in the residue abundance of chloride of sodium. Of course if an obvious precaution is neglected the experiment will fail; if the two dry salts are simply stirred up together in the capsule, and if then the capsule is placed over a spirit-lamp, the chances are that—the mixture not being a sufficiently intimate one—the whole of the chloride of ammonium will volatilise before the temperature rises sufficiently high to bring about the reaction. Authorities are with the scheme on this point. Fresenius, English edition of 1865, edited by Lloyd Bullock, at pages 98 and 101, states that the sulphates of potash and soda, ignited with chloride of ammonium, are converted into their respective chlorides. The edition of 1870, edited by Vacher, repeats the statement. The very process which Mr. Nicholson condemns is taken almost *verbatim* from Fresenius, and at page 542 of the edition of 1865 it is expressly stated that chloride of ammonium is to be added, 'to convert the still remaining sulphate of soda on ignition into chloride.' I will quote one more authority. In the lately published second edition of Sutton's "Volumetric Analysis," at page 287, this direction is given:—'If the water contains but little sulphate the baric chloride may be omitted, and a little ammonium chloride added.'

"Alluding to the molybdate of ammonium process, which is there recommended for the detection of phosphoric acid, Mr. Nicholson says—'It is one of the most untrustworthy known.' Noad, in his "Manual of Analysis," says of this test—'It is especially useful, as it enables the operator to detect the presence of phosphoric acid in minute quantities, in acid solutions of soils, fossils, &c.' Fresenius, in his direction for the qualitative analysis of water, gives this test only for the detection of phosphoric acid. Connington says the test is peculiarly fitted for the detection of small traces of phosphoric acid, as in minerals, soils, deposits from miners'

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Valentin orders it for the detection of the very minute traces of phosphorus in iron. I have myself used the test for many years, and have always found it reliable, and so searching that I do not hesitate to affirm that where this test fails to detect phosphoric acid in the residue, as ordered in the scheme; the presence of that body may safely be disregarded in an analysis made for the purpose of determining the fitness or otherwise of a potable water. I find, by experiment, that if the residue of say 100 c.c. of water contained 0·00002 grm. of phosphoric acid it would be readily recognised by the test, and even so little as 0·00001 grm. is recognisable if the test-tube and contents be allowed to stand some hours.

"The next point, in regard to which I have to defend the chemistry of the scheme, is in the matter of Mr. Nicholson's assertion that, in the process given for the detection of silica, the hydrochloric acid in the presence of nitrates would attack the platinum capsule, so that the residue would, in all probability, be one of platinum and silica. The scheme directs that hydrochloric acid be added to the concentrated water in slight excess, so that even at the commencement of the final evaporation there would be but a very small quantity of free acid in solution. One cannot open any work on chemical analysis without finding such a process; for instance, in Fresenius's edition of 1865, p. 542, this very process is given for the estimation of the silica in water, and the process follows immediately upon that for the estimation of nitric acid in the water.

"Mr. Nicholson complains, not of the principle of the method directed for the recognition of free carbonic acid in water, but that too large a quantity of lime water is directed to be used in applying it. It needs no such calculation as he has employed to prove, what would be patent to any one working the scheme, that a wrong figure had been retained in the text.

"Then Mr. Nicholson has a good deal of objection to make to the directions to evaporate the water down first in a porcelain capsule, and subsequently in a platinum dish. The point was fully considered, and we determined that, under the circumstances in which the operations would generally be conducted, the *alternative* plan as it stands in the scheme might very properly be recommended; and indeed, if the evaporation is not carried too far in the capsule, and if the transference is carefully conducted, the amount of silicates that will be taken from the capsule will be altogether inconsiderable. Of course if the analyst wishes to be very accurate in his estimation of silica, he will, as mentioned in the text, evaporate from first to last in a platinum capsule.

"Mr. Nicholson points out that, in the process for the quantitative estimation of silica, direction to evaporate to dryness, after the addition of the acid, has been omitted. It ought to have occurred to him, I think, that as the process is rightly given in the directions for the qualitative analysis for silica, its omission here was a mere oversight. If Mr. Nicholson will refer to the latest English edition of Fresenius, he will find that the detail dwelt on by him is there omitted in the process for the determination of silica in *potable waters*, while it is inserted in the more lengthy directions for the analysis of *mineral waters*. It has yet to be experimentally proved that the oversight alluded to would lead to serious error in the case of Indian waters.

"Regarding this, and other clerical errors which exist in the scheme, I may say I was prepared for them, for the manuscript, lined and interlined, was twice copied by mere copying clerks, so that I fully intended, on receiving a printed copy of the scheme in Calcutta, to go through the processes with the scheme before me in the laboratory, when any errors of the kind would have been at once discovered; but unfortunately, the very day I received a copy of the scheme, I also learned that Government had decided to stop water analysis in military cantonments in this presidency, intelligence which so vexed and disappointed me that I put the scheme altogether aside.

"As regards the criticisms upon the 6th Bengal Report upon the analysis of potable waters, I did not compile it; its defence may be well left to those who did.

"It is much to be regretted that systematic water analysis is for a time stayed in Bengal, for the new methods of analysis introduced by Messrs. Wanklyn and Chapman are so immeasurably superior to those formerly used, that they certainly ought to be applied to the examination of every important potable water regarding the purity of which there can be any room for doubt."

ON THE

PRODUCTION OF FURFUROL BY THE ACTION OF SUPERHEATED WATER UPON WOOD.

By HUGO MÜLLER.

In confirmation of the results described by Mr. Greville Williams respecting the formation of furfurol by the action of superheated water on wood, I may be permitted to mention some observations which I made some time ago whilst carrying out some experiments on the production of paper-pulp from wood.

In the course of these experiments, I had occasion to examine the action of water on various kinds of wood at a temperature varying from 120° to 180° C., and I then noticed that the resulting aqueous extract exhibited invariably a strong odour resembling very much that of furfurol. Having occasion during last summer to repeat the same kind of experiments with bamboo, I observed the formation of this furfurol-like odour in a still more pronounced and unmistakable degree; and I felt accordingly induced to submit the obtained aqueous extract to a special distillation in order to get some direct proof of the actual presence of furfurol.

Although the quantity of bamboos in this particular experiment amounted to not more than 200 grms., I obtained, after two distillations, an appreciable quantity of a heavy oily liquid, which exhibited all the properties of furfurol, and which on being brought into contact with ammonia at once gave rise to the formation of the well characterised furfuramide.

It would appear from these experiments that superheated water shares with dilute sulphuric acid and chloride of zinc the power of splitting up the peculiar substance recognised by Gudkow some time ago as the furfurol-yielding constituent of all vegetable tissues.

Although the aqueous extract containing the furfurol exhibits a strong acid reaction caused by the presence of some peculiar organic acids, I do not think that the formation of furfurol in this case is due to the action of these acids; on the other hand, I may mention that in treating wood with caustic soda lye instead of pure water, the formation of furfurol appears not to take place.

NOTE ON LITMUS-PAPER.*

By EDWARD R. SQUIBB, M.D.

The rapid progress of medical science, and the consequent improvement in the art of medicine, renders the modern physician much more critical and accurate in his investigation and observation of diseased conditions; and for the means by which to attain greater accuracy and precision in his observations and researches he properly and naturally looks to the pharmacist. In this way, within the past few years, litmus-paper has become an important, if not indispensable agent to the intelligent physician, and he often seeks it, but rarely finds it in the hands of the pharmacist. And when found, it is rarely of the quality or in the condition best adapted to his uses.

* Read before the American Pharmaceutical Association.

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When the physician and pharmacist buy litmus-paper, they generally make the same mistake that the photographer does, and demand that it shall be deep in colour; that the blue shall be very blue, and the red very red. This is wrong in principle and in practice, particularly for physicians' uses, where slight traces of alkalinity or acidity are often important, and the palest instead of the deepest paper should always be selected. The solution made from 1 lb. of good litmus commonly requires about 200 grains of concentrated sulphuric acid to saturate it up to the point at which the colour *begins* to change to purple in its course toward redness, and this purplish tinge of pale blue, and the corresponding purplish tinge of pale red are the desirable colours, between which is the least margin of difference which is left undetected by the testing.

This large proportionate quantity of sulphuric acid indicates how comparatively roughly the carelessly made and deeply coloured litmus-papers fulfil their design; and it is the object of this note to indicate a better practice, and a better state of knowledge on this subject. To prepare good litmus-paper, the following formula may be useful:—

Take of—

Good litmus, in fine powder	1 part.
Water	4 parts.
Alcohol	1 part, all by weight.

Put these ingredients into a bottle, and shake the mixture occasionally during 24 hours; allow the sediment to settle out completely, and decant as much as possible of the clear liquid into another vessel; then put the same quantity of water and alcohol upon the sediment, shake again, and when again well settled, pour off the clear liquid for use in diluting the first portion of liquid, or for dissolving a fresh portion of litmus. Separate about one-fourth part of the first clear liquid, and add to the remainder dilute sulphuric acid until it becomes of a purple tint, or gives a purplish-blue colour to a slip of white paper; then add about one-half of the separated fourth part of the solution, and if this should entirely restore the original pure blue colour, again add diluted acid until a purplish tint is again obtained; then add the remaining eighth part of the original solution to restore the pure blue colour, or which is more delicate as a test for acidity, a very faintly purple-blue colour; then dilute this solution either with water, or with the second liquid from the litmus sediment until a slip of neutral white paper dipped into it has a pale blue or pale purplish-blue colour. Here it is necessary to remember that this paper when dry is many shades paler than when wet, and the dilution should be made accordingly. The solution for making red litmus-paper will not bear the same amount of dilution as that for the blue, and must be made of the proper purplish-red colour by the addition of dilute acid before dilution. The solutions so made will keep almost indefinitely, and may be passed on from one process to the next. The paper should be made from pure rag stock —not from bleached wood nor straw—should be quite white, and above all, must be quite neutral, and show no red spots or blotches when moistened with the blue solution. French or German filtering-paper commonly answers well if of good quality. This is cut into convenient size, the larger the better, because there is less waste, and held by two corners, which corners are to be kept dry; it is to be skilfully laid on the surface of the solution, first one side and then the other, then drained, and hung over clean glass tubes to dry. The vessel to hold the solution for dipping should be larger than the sheet of paper, and shallow.

The sheets when dry are laid together, and the edges trimmed off all round. They are then cut into sheets 3 to 4 inches wide and 12 to 18 inches long, according to the size of the paper used. What is sold as "a sheet of litmus-paper," should never be less than 4 inches by 12, or 3 by 18. Such a sheet cut lengthwise through the middle gives a strip which when cut crosswise into strips a quarter or three-eighths of an inch wide, is of a very convenient size and form for use. The sheets, one paler and one deeper of the same colour, if desired, should be rolled up together in a tight roll, slipped into a test-tube and corked. An ordinary 5-inch test-tube holds the sheets conveniently, and one such tube of the red and one of the blue, properly labelled, forms a convenient pair, such as is supplied to the U.S. army by the writer. Formerly these sheets were enveloped in tin-foil; but though they thus keep much better than in paper, they are when pale and delicate very liable to be changed and spoiled by the alkaline and acid vapours in the air. In corked test-tubes they keep unchanged for an indefinite time, while the test-tubes and corks when empty are always worth their cost to those who use litmus paper.

In this form of sheets, however, the paper is not so convenient for the physician as when cut into strips 1 to 2 inches long and a quarter of an inch wide; and the writer finds that about 100 of such strips, put up in a wide-mouth tube vial, corked and properly labelled, is a most convenient and popular form for physicians' use. One such vial of each colour put up together forms a pair which no physician should be without. And most physicians will buy them if they can get them. These convenient little strips may be shaken out of the vial as wanted for use, but as the fingers should, by rights, never touch any other strip than the one taken, it is best to take them from the vial by a pair of forceps from the physician's pocket-case.

ON A

NEW APPLICATION OF TUBE HYDROMETERS.

By WILSON H. PILE, M.D.

In an article read before the American Pharmaceutical Association in Baltimore, 1870, I endeavoured to render intelligible a new method by which the relation between the degrees of Baumé's hydrometer and specific gravity could be easily determined; and, as the method there pointed out is intimately connected with the present subject, I will briefly recapitulate the main points.

A plain cylindrical tube of thin glass, closed at its lower end, is to be immersed in pure water, at a temperature of 60° F., and then loaded by pouring in shot or mercury until it sinks about two-thirds of its length in the water, the point to which the surface of the water rises being then marked on the tube. If now that part of the tube which was immersed in the water be divided into 145 parts, and these parts numbered from the top downwards, the tube will represent a Baumé's hydrometer for liquids heavier than water, and by floating it in any liquid of greater density than water its degree will be seen on the tube at the surface of the liquid.

These degrees can be marked on paper, and the paper inserted in the tube and pushed down to the bottom, the upper mark, or zero, being exactly opposite the mark which had been previously made on the tube.

We will now proceed to show a new application of these tube hydrometers in determining densities.

Having immersed a tube, closed at the lower end as before, in water, we pour water into the tube until it sinks about two-thirds of its length.

It should float upright. We are now to mark the surface of the water in which the tube floats, and also the surface of the water within the tube. The tube below this latter mark must then be divided into 145 parts, either by etching on the glass or—what is more practical —by drawing a scale on paper, numbering the degrees from the top (0°) downwards. In ascertaining the density of any liquid heavier than water, the tube must be emptied, and dried by rinsing with alcohol and drawing air through it by means of a long tube, then immersed in water of 60° F., and the liquid to be tried poured in until the tube sinks to the upper mark. It can then be taken out, and

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the degree of density shown on the tube, if it be etched, or else by holding it on the paper scale in its proper position.

Our illustrations have been thus far for liquids heavier than water; for those lighter than water the tubes or scales require a different division. Unfortunately, Baumé's method of dividing his hydrometers rendered the degrees for those of light liquids larger than those for heavy liquids, and by comparison we find they are in the ratio of 145 to 140. In order, therefore, to make a scale for light liquids, we divide the space below the surface of the water within the tube into 140 parts, instead of 145 parts as at first; the degrees are then continued upwards 70 or more parts. These divisions are numbered at the water point 10° (another peculiarity of Baumé's scale, and running upwards as high as desired. The scale below the water point need not be marked, as it can be only used for liquids lighter than water.

The tube is used for all liquids in the same manner, namely, by pouring into it the liquid to be tried until it sinks in water down to the mark made at first on the tube; then by holding it against the paper scale marked as just described. The surface of the liquid will indicate its proper degree of density.

An advantage which the tube when used in this manner possesses, is the small quantity of liquid necessary, as the tube can be made quite small in diameter, and by increasing its length the degrees are rendered larger, and thus greater accuracy is obtained. It may also be employed in ascertaining the density of extremely heavy liquids, where no hydrometer could be found of service.

ON THE DETERMINATION OF THE TRUE ZERO OF THERMOMETERS.

By Ch. TELLIER.

It is generally admitted that the 0° of the Centigrade and Réaumur thermometers varies after a longer or shorter time, and the delicate and sensitive thermometers therefore become altered as regards the indication of the 0° when placed in melting ice or snow. According to the observations on the supersaturation of water with cold (see CHEMICAL NEWS, vol. xxvi., p. 107) thermometers are much less variable than is generally supposed, and the cause of the differences which are observed is probably due to an error made in the determination of the 0°. It may be readily conceived that unless special precautions are taken at the time of the graduation of the thermometer, the water in which it is plunged, and which is supposed to be precisely at the temperature of melting ice, may in reality be slightly above that temperature; this is the case if the walls of the vessel containing the water and ice admit more heat to the water than the melting ice can overpower: this is natural; ice does not melt instantaneously, but only in the ratio of its surface, and in proportion to the difference of the temperature of the water in which it floats, and its own temperature; and it is consequently quite possible that the water which contains the ice is not at a temperature of 0°. The colder the water the more slowly will equilibrium of temperature be established between the two bodies, and in the same ratio will the chances of error be greater. The error of indications of the thermometers brought on by time either depends upon a modification in the glass, as usually admitted, or it is due to the result of an erroneous estimation of the 0°. In the first case the alteration would rather tend to *plus* in one case and to *minus* in the other, and there is no plausible reason why it should be otherwise; in the second case (erroneous estimation of the 0°) the error should be always *plus*, because the water must be above 0°. My experiments have confirmed these views. I have taken seven thermometers with the graduation engraved on the stem and made by one of the best makers; only one of these instruments has been found to indicate 0° correctly, all the others indicated a difference—

2	indicated	+ 0·1
1	,,	+ 0·2
2	,,	+ 0·3
1	,,	+ 0·4

Not one of these thermometers indicated below 0°.

The determination of the 0° by placing the thermometer in melting ice is therefore not an absolutely certain method of operating. In order to find the true 0° another plan must be followed, which is that found and described by me, and called *terminus of congelation*. The operation is carried on as follows:—A glass vessel is placed in a refrigerating mixture, and the temperature of the water contained in the vessel is thereby readily lowered to −2 or to −3: this having been done, the vessel is removed from the mixture, and the thermometers to be graduated are placed in it, with a small piece of ice; hereby the water becomes suddenly frozen, while at the same time the temperature rises to 0°. When one has no ice at hand, and in order not to complicate the operation, the temperature of the water should be brought down to −4°, when, by giving a gentle tap with a glass rod to the bottom of the vessel, the phenomenon of congelation of the water will be observed, the temperature rising to the true 0° absolutely. I draw from the foregoing the two following conclusions:—

1. That the expression of melting ice does not exactly indicate the true 0°, and that therefore it ought not to be the basis of the determination of that point.

2. That by applying the term of *terminus* of congelation it is quite possible to estimate with certainty the exact point which separates liquid water from ice, and that point is the true 0°, which should be the starting point of the graduation of the thermometer scale.—*Revue Hebdomadaire de Chimie.*

CORRESPONDENCE.

TELEGRAPHIC EXPERIMENT.

To the Editor of the Chemical News.

SIR,—The following experiment may interest your readers.

On November 4th the cable from Dover to Boulogne was broken by a ship's anchor, about 5 miles from Dover. By the kind permission and co-operation of Mr. Bourdeaux, the engineer of the Submarine Telegraph Company, I placed my instrument (as shown lately before the Society of Arts, and described at the time in your Journal) between the end of the broken cable at Dover and the water-pipes of the town. To our surprise we could distinctly read every message to and from Ostend, Calais, and Dover, on the Dover-Ostend, and Dover and Calais cables. The explanation was as follows: —Part of the electrical current which went to earth at the Dover water-pipes went on to a second earth formed by the end of the broken cable, and in its passage made signals on the instrument. Thus the enormous fault formed by the Dover water-pipes was not sufficient to prevent a perceptible current of electricity passing on to the broken end of the Dover and Boulogne cable.

We also asked the French operator at Boulogne to send a current through the broken cable, and got a feeble result; but as we were not able, without special authorisation from the French Government, to get him to put on such batteries and instruments at Boulogne as were necessary, and the remaining cables were fully occupied with messages, we did not follow out this portion of the experiment. The first experiment, however, shows what an enormous fault may exist without preventing the action of

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the delicate instrument, which I described in a former number of your Journal.—I am, &c.,

H. HIGHTON.

Putney, November 12th, 1872.

PREVENTING EXPLOSIONS IN COAL-MINES.

To the Editor of the Chemical News.

SIR,—By way of addition to my note "On a Means of Preventing Explosions in Coal-Mines," inserted in the CHEMICAL NEWS for October 25th, I beg leave to remark that in many mines the process of periodical partial exhaustion by air-pumps, followed by forcing a powerful current of air through the entire workings of the pit, would probably prove sufficient to prevent any dangerous accumulations of gas. For this purpose it would merely be necessary to have two iron plates (with suitable stop-cocks) one to cover each shaft, and to connect one or both of these with air-pumps, so as either to partially exhaust or drive in air at pleasure.—I am, &c.,

JOHN A. R. NEWLANDS, F.C.S.

9, Mincing Lane, E.C.,
November 18, 1872.

CONSTITUTION OF MATTER.

To the Editor of the Chemical News.

SIR,—Before proceeding to examine Mr. Kingzett's "objections to my arguments," I will attempt to state more fully the primitive acts and ideas on which those arguments were founded.

Matter viewed from a *physical* point of view is, in its nature, *one*. It is seen to possess the common properties of weight, extension or form, and stability, all other properties being merely conditions. It is composed of inconceivably minute particles, or atoms, which possess, like the masses of matter they compose, the common properties of weight, form or extension, and stability; but they also possess another property, of which masses of matter are destitute, viz., indivisibility. They are not alike in size or weight, but exist in great diversity of both.

Being not composed of parts, it is impossible to diminish their size by friction or "wearing" (which is a rubbing off of atoms), or by breaking (which is the act of opening matter where molecular divisions already exist); and it is impossible to increase their size by the addition of matter, because they are inflexible, and two atoms will not amalgamate together to form a larger atom (placing two atoms in contact would no more be increasing the size of one of the atoms than placing two marbles in contact would be increasing the size of either of the marbles). It is also impossible to increase their size by expansion by heat (which is the act of increasing the inter-atomic spaces of a mass of matter), because they are not composed of atoms, and have no inter-atomic spaces; and it is possible to decrease their size by cold (which is the act of decreasing the inter-atomic spaces) from the same reason.

Therefore the various atoms always retain their respective sizes, under whatever conditions the masses of matter they compose may be placed.

These variously-sized atoms, when collected into masses in their respective sizes, constitute and form a number of bodies which we call chemical elements. Each mass, owing to the different size of its component atoms, and the consequent different effect of the forces on these atoms, exhibits, when compared with the other masses, certain marked differences in its behaviour, which differences are called chemical properties. It is seen that, if all the forces could be withdrawn, "we should have matter reduced to (chemical) simplicity," because matter would then present one uniform absence of chemical properties.

But one element can never be converted into another; because, though the play of the forces developes chemical properties, yet the atomic sizes which influence the play of the forces can never be altered by the alteration or "withdrawal of the forces."

Mr. Kingzett thinks I have "made a serious error by saying the withdrawal of the forces cannot alter the atomic sizes." "Would it not," says he, "be wiser to say the atomic size is an effect of force? For, if not, the atomic volume at 100° C. would be the same as at 0° C." Mr. Kingzett has here been guilty of "confusing matter and force." The increase in volume caused by the heat is not due to an increase in the size of the atoms, but to an augmentation of the inter-atomic spaces. Whether I have demonstrated the "most important fact," that the atoms are incapable of alteration in size, I leave it for Mr. Kingzett to consider. By mechanical means, such as crystallisation, heating from a low to a high temperature, &c., it is possible to alter the molecular arrangement, but not the chemical nature, of an element. For instance, "the diamond, graphite, and charcoal are constituted of the same matter, though the qualities of each are very different; the difference arises from molecular arrangement, or, in other words, from the ultimate particles being differently operated upon." "Yet we can burn all three forms into CO_3;" which proves the identity of the chemical nature of the three forms, in spite of the fact that their "particles are differently operated upon."

To the rule that chemical nature depends on the atomic sizes, there are five known exceptions; yet a very slight difference in the form of the atom, or an exceedingly fractional error in the estimation of the atomic weight, would be sufficient to account for a difference in the chemical behaviour of two bodies whose atoms are supposed to be of the same size.

"If," asks Mr. Kingzett, "atoms are not composed of atoms, what are they composed of?" This would lead one to conclude that Mr. Kingzett advocates the antiquarian theory of the infinite divisibility of matter; he did not pay sufficient attention to the word *ultimate*, which preceded the word *atom*.

If he finds a difficulty in conceiving the idea of an atom possessed of extension and devoid of divisions, I find an equal difficulty in forming any conception of an atom containing an infinite number of divisions yet possessed of stability. Divisions are space, and where space exists matter is not. Therefore, if the divisions or spaces are infinite, there is no room for matter left; or, in other words, matter cannot exist.

"If," says Mr. Kingzett, "matter cannot exist without force, then force must exert an influence over matter under any circumstances,—therefore the size or volume of atoms is influenced by force." Mr. Kingzett places a dash between the words "circumstances" and "therefore." What mysterious train of thought is this intended to represent? I confess I am unable to see it.

Mr. Kingzett should recollect that, if "all the forces could be withdrawn, we should have matter," not annihilated, but "reduced to simplicity;" and therefore matter can exist without force.—I am, &c.,

JOHN F. SUTTON.

MISCELLANEOUS.

Indian Cinchona Alkaloid Factory.—We understand that Dr. Simpson of Patna, has declined the superintendence of the Cinchona Alkaloid Factory at Rungbee, in Sikkim, and that the Indian Government have sent home for some one to fill the appointment. We hope that an experienced chemist will be appointed.

Chemistry at Cambridge.—The Master and Fellows of Gonville and Caius College at Cambridge have recently determined to appoint a Prælector in Chemistry to superintend the College Laboratory, and to have charge of the chemical studies of the students there. The stipend will be £200 a year, and the Prælector will have

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status of a Fellow of the College. The election will take place about the middle of next month.

Royal Society.—The Medals in the gift of the Royal Society have this year been awarded as follows:—The Copley Medal has been awarded to Professor Friedrich Wöhler, of Göttingen, For. Memb. R.S., for his numerous contributions to the Science of Chemistry, and more especially for his researches on the products of the decomposition of Cyanogen by Ammonia; on the Derivatives of Uric Acid; on the Benzoyl Series; on Boron, Sillicon, and their compounds; on Titanium, and on Meteoric Stones. A Royal Medal has been awarded to Prof. Thomas Anderson, M.D., for his investigations on the Organic Bases of Dippell's Animal Oil; on Codeine; on the Crystallised Constituents of Opium; on Piperin and on Papaverin; and for his researches in Physiological and Agricultural Chemistry. A Royal Medal has been awarded to Mr. Henry John Carter, F.R.S., for his long-continued and valuable researches in Zoology, and more especially for his inquiries into the Natural History of the Spongiadæ. The Romford medal, awarded every two years, has been awarded to Anders Jonas Angström, For. Memb. R.S., for his Researches on Spectral Analysis. The annual meeting of the Fellows of the Society, for the election of Officers and Council for the ensuing year, will be held on the 30th inst. We understand that Prof. Huxley has been nominated by the Council as successor to Dr. Sharpey, who, after a long period of service as Secretary, resigns his office.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, November 11, 1872.

This number contains the following original papers and memoirs more particularly relating to chemistry:—

Composition of Chloride of Lime.—J. Kolb.—The contents of this paper relate to researches made by the author in 1867, and then published in the above-named periodical, as well as in the *Annales de Chimie et de Physique*. These researches are here referred to to correct some errors which the author considers were contained in a paper by Dr. Crace Calvert, published in the *Comptes Rendus* of 27th May last.

Causes of the Loss of Sodium in Leblanc's Soda-Making Process.—A. Scheurer-Kestner.—After first referring to his former essay on this subject (see CHEMICAL NEWS, vol. xxii., p. 267), the author states that the loss of sodium retained in the waste increases proportionately with the quantity of chalk employed. When for 100 sulphate of sodium the quantity of chalk amounts to 98, the quantity of sodium retained in the waste is 0·59 per cent; for 102 chalk to 100 sulphate of sodium, 0·86 per cent; for 111 chalk to 100 sulphate of sodium, 1·30 per cent. The greater part of the excess of chalk is converted during the calcination process into lime; and when the crude soda is lixiviated with water, the lime, while becoming hydrated, reacts upon the carbonate of sodium, and thereby renders a portion insoluble in water. According to a series of experiments made by the author, the lime may retain even as much as from 4·75 to 4·95 per cent of soda, calculated dry. The greater or less porosity (density) of the ball-soda also exerts some influence; the waste from porous ball-soda was found to contain 1·44 per cent, that from dense ball-soda 1·97 per cent of soda. In order to diminish as much as possible the loss of sodium, the quantity of chalk to be employed should be reduced as much as possible, and the thoroughly calcined mass should be withdrawn from the furnace when it gives off copiously carbonic oxide gas, which is only formed when the operation is nearly finished; the evolution of this gas being due to the action of the coal upon the limestone compound, viz., reduction of the carbonate to caustic lime.

Neutral Combinations of Mannite and its Hydrates.—G. Bouchardat.—This essay treats on dichlorhydric mannite—

$$C_{12}H_8(H_2O_2)_4(HCl),$$

a crystalline body soluble in cold water, insoluble in absolute alcohol and ether; fuses at 174°, but is then also decomposed, as is also the case when it is dissolved in boiling water, the result being the formation of monochlorhydric mannitane and HCl. The former is a neutral compound readily soluble in all proportions in water, alcohol, and in ether. When dichlorhydric mannite is treated with nitro-sulphuric acid, it is converted into hydro-chloro-nitro mannite, a solid substance insoluble in water, soluble in alcohol, not explosive; dibromhydric mannite, $C_{12}H_8(H_2O_2)_4(HBr)_2$, also a solid body insoluble in cold water, alcohol, and ether; fuses at 178° with decomposition, which also ensues when this compound is treated with boiling water, thereby yielding monobromhydric mannitane, $C_{12}H_8(H_2O_2)_4(HBr)$, a compound readily soluble in water, alcohol, and ether.

Researches on Santonine.—L. de Saint Martin.—Santonine is the active principle of the *Semina santonici*. The author has investigated santonine with the view of establishing its chemical character. If santonine is really a phenol its formula, $C_{30}H_{18}O_6$, indicates that it must yield by reduction:—(1) a diatomic phenol, $C_{30}H_{18}O_4$; (2) a monoatomic phenol, $C_{30}H_{18}O_5$; (3) a hydrocarbon, $C_{30}H_{18}$. The author has prepared, by treating santonine with zinc filings at a high temperature, santonol—a phenol $C_{30}H_{18}O_2$—which in a pure state is similar to stearine, and fuses at 135°. It is insoluble in water, readily soluble in alcohol and ether, yielding with sulphuric acid a sulpho-conjugate compound.

Researches on the Functions and Transformation of Mouldiness.—A. Béchamp.—This lengthy essay contains the record of a series of experiments made with the view to prove that, chemically, mouldiness is ferment, and that there exists in that respect no real difference between the cryptogamic plants, vulgarly termed mouldiness and yeast.

Fermentation of Fruit.—G. Lechartier and F. Bellamy.—This paper treats at length on the changes which fruit, apples, pears, cherries, potatoes, and chesnuts undergo when kept for a long period in closed vessels. It appears that previous to becoming quite rotten, fruit yields under these conditions alcohol and carbonic acid; which is also evolved from grain and from linseed when sufficiently moist, and kept under the same condition for a long time.

Estimation of Manganese in Soils and in Plants.—A. Leclerc.—Reserved for full translation.

This number contains a series of papers relating to the discussion on fermentation, and a number of papers relating to astronomy, meteorology, geology, botany, physiology, and anatomy.

La Revue Scientifique de la France et de l'Etranger, November 16, 1872.

This number contains no papers relating to chemistry, but we call attention to the following memoir:—

The Troglodytes of Vezère.—P. Broca.—The illustrated account of an extinct race of mankind, of which fossil remnants are found at and near Vezère. There is added to this memoir an account of the excursion from Bordeaux to Eyzies, during the meeting of the French Association for the Advancement of Science, for the purpose of visiting the bone cavern.

Revue Universelle des Mines, de la Metallurgie, des Travaux Publics, des Sciences et des Arts Appliqués à l'Industrie, June, 1872.

In addition to several original papers strictly relating to engineering and collateral subjects, this number contains an exhaustive memoir—

Chilian Amalgamation Method.—E. Fonseca.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, November 7, 1872.

Review of the Contents of the International Exhibition Held at Paris in 1872.—C. Mène.—This first portion of a review of the exhibition of products of domestic economy treats, in the first place, on the origin and history of the exhibition, and, next, on the objects sent in from La Martinique, one of the French colonies.

Manufacture of Perfumed Soaps.—MM. Beyer Brothers.—An illustrated account exhibiting the machinery and tools for the industrial preparation of perfumed soaps.

Improved Method of Obtaining Sea-Salt.—M. Roulleau.—The author describes the method of construction of the so-called salt-gardens, so as to obtain by one evaporation of sea-water (spontaneous evaporation by exposure to open air) a clean and white-coloured salt, this method of construction being especially adapted to sandy and marshy sea-shores.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 16, 1872.

Before proceeding with the ordinary business of the meeting of this society, the President, Dr. A. W. Hofmann, announced that the Runge memorial monument, the erection of which was first proposed by this society, was finished, and would shortly be placed in the cemetery at Oranienburg; the monument is beautifully executed.

This number contains the following original papers and memoirs:—

On Kieserite, its Properties and Applications.—H. Grüneberg.—Kieserite, ($MgSO_4,H_2O$), is a native product of the Stassfurt saline deposit, and is distinguished from the ordinary sulphate of magnesia, ($MgSO_4,7H_2O$), by its being less soluble in water. The author describes at length the industrial method applied at Stassfurt for purifying this salt, so that it is sent off at 60 per cent $MgSO_4$, it being

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extensively used for dressing cotton and other textile fabrics at Manchester. A large quantity of kieserite is employed in winter for preparing, by double decomposition at a low temperature, sulphate of soda from common salt; the kieserite is also used as manure, and the author has succeeded in making a double salt of kieserite and gypsum, which—prepared by first mixing the two salts together, igniting this mixture, and next treating it with cold water—yields a hard marble-like mass, which, when pulverised and mixed with water, may be moulded in any shape, rapidly becoming as hard as stone, and unalterable by atmospheric agency.

The Liebenfrauensee at Kissingen.—C. Bender.—It appears that there is situated near Kissingen a small lake (size of surface, 1076 square metres), from which gas is permanently evolved in rather large bubbles; this gas was found by the author to consist, in 100 parts, of—Nitrogen, 84·6 per cent, and oxygen, 15·4; while the gas absorbed by the water was found to consist, a deduction being made for carbonic acid, of—Nitrogen, 74·7 per cent, and oxygen, 25·3. Assuming that in every second one gas-bubble of 10 c.c. is evolved per square metre of surface from this sheet of water, the quantity of nitrogen evolved in the atmosphere amounts per second to 9·1 litres. The author describes at length, and illustrates with woodcuts, the ingeniously-contrived apparatus employed by him in making these researches on the spot.

On Quercite-Sulphuric Acid, and on a Kind of Sugar Separated from it which Differs from Quercite.—C. Scheibler.—Braconnot discovered in acorns in the year 1849 a peculiar kind of sugar, termed quercite, which has the formula $C_6H_{12}O_5$, and of which Dessaignes (*Ann. d. Chem. u. Pharm.*, vol. lxxxi., p. 103) states that it yields with sulphuric acid a conjugate quercite-sulphuric acid. The author has recently prepared quercite and this acid in larger quantity, and says that the barium, calcium, zinc, cadmium, and copper salts of this acid are all amorphous resin-like materials. The aqueous solution of the barium salt, when heated to from 120° to 130° in a sealed tube, is split up into sulphate of baryta, free sulphuric acid, and a new kind of sugar, which is not quercite, and which the author believes to be identical with mannite or dulcite, and to be formed from quercite by taking up 1 molecule of water; further researches are, however, being made.

On Pheno-Chinon and Similar Compounds.—H. Wichelhaus.—After first referring to his former researches on the oxidation of phenol (see Chemical News, vol. xxv., p. 190), the author records in this memoir, elucidated by a lengthy series of complex formulæ, his researches on pyrogallo-chinon, chinhydron, pheno-chinon, and purpuro-gallin, the formulæ of which are, respectively—

1. Purpuro-gallin.—$C_{18}H_{14}O_4 = C_6H_4\begin{matrix}O.O.C_6H_3\\O.O.C_6H_3\end{matrix}$
2. Pheno-chinon.—$C_{18}H_{14}O_6 = C_6H_4\begin{matrix}O.O.C_6H_4.OH\\O.O.C_6H_4.OH\end{matrix}$
3. Chinhydron.—$C_{18}H_{14}O_6 = C_6H_4\begin{matrix}O.O.C_6H_4(OH)_2\\O.O.C_6H_4(OH)_2\end{matrix}$
4. Pyrogallo-chinon.—$C_{18}H_{14}O_9 = HO.C_6H_2\begin{matrix}O.O.C_6H_4(OH)_2\\O.O.C_6H_4(OH)_2\end{matrix}$

The author further treats on the reaction between pheno-chinon and aniline, whereby a body identical with chinon-anilid is formed.

New Phenol-Sulpho Acid.—J. Post.—After briefly referring to the researches of Kekulé, Kolbe, and Gauhe on phenol-sulpho acids obtained from nitro-phenol, the author states that he has obtained, by treating orthonitro-phenol, which fuses at 110°, with fuming sulphuric acid, a new phenol-sulpho acid different from those hitherto known. The lime salt of this substance is a solid crystalline body; formula—

$$C_6H_3\left\{\begin{matrix}NO_2\\O\\SO_3O\end{matrix}\right\}Ca + 2\tfrac{1}{2}H_2O.$$

The composition of the baryta salt is similar to that just mentioned, but the acid itself has not been isolated in pure state.

On some of the Derivatives of Uramido-Dracylic Acid.—P. Griess.—This essay treats on nitro-amido-dracylic acid—

$$C_7H_4(NO_2)(NH_2)O_2,$$

a solid, crystalline, deep yellow-coloured body, difficultly soluble in boiling water, but more readily so in boiling alcohol. The barium salt of this acid has in air-dry state the formula—

$$(C_7H_3(NH_2)(NO_2)O_4)_2Ba + 5H_2O.$$

The author further refers to the action of tin and hydrochloric acid upon nitro-amido-dracylic acid, on oxynitro-dracylic acid, and on β-oxynitro-benzoic acid.

Structure of Isomorphous Crystals.—H. Baumhauer.—A crystallographical essay.

Means of Regulating Gas-Flames so as to Obtain a Constant Temperature Higher than that of the Boiling-Point of Mercury.—J. Myers.—Reserved for full translation.

New Hydrocarbon Isomeric with Anthracen.—C. Graebe.—When crude anthracen is treated with benzol or sulphide of carbon, the filtrate of these solutions contains several hydrocarbons, only one of which, viz., acenaphthen, has been isolated and studied. It appears that Dr. Glaser, while working with crude anthracen on the large scale, has found a new hydrocarbon, which he has sent to the author for further investigation. The new compound, $C_{14}H_{10}$, is in many respects akin to anthracen; it crystallises, exhibits fluorescence, fuses at 105°, boils at 340°, is hardly soluble in cold, more readily so in hot, alcohol, and is very soluble in benzol, ether, and sulphide of carbon; vapour density, 6·28 (theoretically 6·16); it combines with picric acid, and behaves like anthracen with chromic acid.

Chlorine Derivatives of Aceton.—C. Bischoff.—This exhaustive monograph is divided into the following sections:—Introduction, containing a concise *resumé* of the labours of other *savants* on this subject; monochlor-aceton-cyanhydrogen; monochlor-acetonic acid; salts of this acid.

Mono-Oxyanthrachinon and Anthraflavinic Acid.—C. Liebermann.—The results of the author's renewed investigation of these bodies; these results agree with those published in the *Ann. d. Chem. u. Pharm.*, vol. clx., p. 141.

Decomposition of Nitrated Anisols by Ammonia, and on the Constitution of Tri-Amido-Benzol.—H. Salkowski.—Notwithstanding its high scientific value, this essay is not suited for abstraction.

Action of Phosphoric Perchloride upon Sulphon Acids.—G. A. Barbaglia and A. Kekulé.—It appears from the researches recorded in this essay that the sulpho group of the phenol-sulphon acids is decomposed by phosphoric perchloride, with the formation of thionyl chloride—

$$C_6H_4\left\{\begin{matrix}SO_2H\\OH\end{matrix}\right.$$

yields—

$$C_6H_4\left\{\begin{matrix}SO_2Cl\\OH\end{matrix}\right.$$

and next—

$$C_6H_4\left\{\begin{matrix}Cl\\OH\end{matrix}\right.$$

and then—

$$C_6H_4\left\{\begin{matrix}Cl\\Cl\end{matrix}\right.$$

while, at the same time, there is formed—

$$C_6H_4\left\{\begin{matrix}Cl\\O.PO.(OH)_2\end{matrix}\right.$$

On some of the Substitution Products of Dimethylaniline.—G. Krell.—This essay treats on—Monochlor-dimethylaniline—

$$\left.\begin{matrix}C_6H_4Cl\\CH_3\\CH_3\end{matrix}\right\}N;$$

dichlor-dimethylaniline—

$$\left.\begin{matrix}C_6H_3Cl_2\\CH_3\\CH_3\end{matrix}\right\}N;$$

trichlor-dimethylaniline—

$$\left.\begin{matrix}C_6H_2Cl_3\\CH_3\\CH_3\end{matrix}\right\}N;$$

dinitro-dimethylaniline—

$$\left.\begin{matrix}C_6H_3(NO_2)_2\\CH_3\\CH_3\end{matrix}\right\}N;$$

and trinitro-dimethylaniline—

$$\left.\begin{matrix}C_6H_2(NO_2)_3\\CH_3\\CH_3\end{matrix}\right\}N;$$

Bayerisches Industrie und Gewerbe-Blatt, October, 1872.

This number contains no original papers relating to chemistry.

Pharmaceutische Zeitschrift für Russland, No. 15, 1872.

The original papers contained in this number strictly bear only upon pharmacy.

Nos. 16 and 17, 1872.

Testing of Fatty Oils.—H. Ludwig.—This monograph is divided into the following sections:—Colour of the oils; smell and taste of the oils; difference of fluidity and of forming drops of the oils; freezing-point of the oils; capability of drying of the oils; specific gravity—viz., oils the sp. gr. of which is between 0·900 and 0·920; between 0·920 and 0·935; above 0·935; elementary composition of some fatty oils; fatty oils and alcohol; behaviour of fatty oils with polarised light; testing the oils for admixture of resin oil; amount of heat evolved when the oils are mixed with strong sulphuric acid; colouration of fatty oils by concentrated sulphuric acid; action of syrup-like phosphoric acid, $3HO,PO_5$, and oils; behaviour of the oils with nitrous-nitric acid (acidum nitroso-nitricum); fatty oils and nitric acid; peroxide of hydrogen and fatty oils; nitro-sulphuric acid and the fatty oils; chlorine and fatty oils; nitro-hydrochloric acid and fatty oils; caustic soda solution (sp. gr., 1·34) and the oils; dry hydrate of lime and the oils; Bolley's test (solution of carbonate of potassa) and the oils; Seyfried's test (acetate of lead); detection of the oil from *Cruciferæ* by the sulphur they contain; behaviour of some fat oils when heated; action of bichromate of potassa and dilute sulphuric acid upon oils; permanganate of potassa and fatty oils.

No. 18, 1872.

This number only contains original papers relating to pharmacy.

Les Mondes, November 14, 1872.

Project of an Atmospheric Submarine Postal Communication between France and England.—E. Martin.—In this paper the author describes a modified plan, which consists in the use of a narrow tube through which simply microscopic photograms containing the dispatches, produced upon collodiun, are to be transmitted. It appears that this method of operating was first used during the late siege of Paris, and has now been improved upon. The execution of these microscopic photograms can be conducted by day or at night by the aid of the electric light. The tube through which these light pellicules are to be transmitted need only be some few centimetres in diameter. The motion is imparted by compressed air.

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Bibliography.—Under this heading attention is called to the following work:—"Recherches sur les Causes et les lois des Mouvements de l'Atmosphère," par J. M. Sanna-Solaro, S.J. (Paris, 1872). This volume, which is highly spoken of by its reviewer, treats on the meteorological phenomena of our atmosphere.

Obituary.—We regret to announce the death of a well-known scientific chemist, M. Poinsot, who for many years has been Assistant Professor at the Conservatoire des Arts et Métiers, and at the Ecole Centrale des Arts et des Manufactures. The deceased worked during many years with the late Professor Payen, and his researches on agricultural chemistry are well and deservedly known.

American Journal of Pharmacy, November, 1872.

In addition to original papers and memoirs strictly relating to pharmaceutical sciences, this number contains the following original papers relating to chemistry:—

New Application of Tube Hydrometers.—Dr. W. H. Pile.—Reproduced in full.

Notes on Benzoin.—A. C. Curtis.—The results of the author's researches may be summarised as follows:—That benzoin contains, in addition to benzoic, a not inconsiderable quantity of cinnamic acid, which can be obtained in free state by boiling the resin with double its bulk of lime, in forty times its own weight of water, for fifteen minutes, filtering, cooling, acidulating strongly with hydrochloric acid, washing the precipitate, and re-crystallising from water acidulated with HCl. The benzoic acid is best obtained from the resin by sublimation, and is in that way procured free from cinnamic acid. Some benzoin contains about one-fourth of impurities, and therefore its pharmaceutical preparations are deficient in strength unless an allowance be made for the impurities.

PATENTS.

Communicated by Messrs. VAUGHAN and SON, Patent Agents, 54, Chancery Lane, London, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

3014. S. H. Johnson, F.C.S., Stratford, Essex, "Improvements in the method of, and apparatus for, separating the soluble constituents of substances from the insoluble constituents."—Petition recorded October 12, 1872.

3202. W. Thompson, Wandsworth Road, Surrey, "Improvements in the manufacture of white-lead, and apparatus therefor."—Petition recorded October 29, 1872.

3250. P. Forbes, Houndsditch, London, "Improvements in means or apparatus for the preservation of substances for food."

3252. E. Withy, and W. Gibson, West Hartlepool, Durham, "Improvements in mixing, charging, and smelting iron ores."

3261. J. A. Wanklyn, Harrington Street, Hampstead Road, Middlesex, "Improvements in the production of oxygen gas."—Petitions recorded November 2, 1872.

3273. J. B. Spence, Manchester, "Improvements in obtaining anthracene, and in apparatus connected therewith."—A communication from J. C. F. Cheever, New York, U.S.A.—Petition recorded November 4, 1872.

3292. E. I. W. Parnacott, Leeds, "Improvements in artificial fuel, part of which improvements having reference to the means or apparatus employed in the manufacture of the same."—Petition recorded November 6, 1872.

NOTICES TO PROCEED.

2003. W. Thwaites, Brixton, Surrey, E. Fondeville and G. Bertin, Kentish Town, Middlesex, "Improvements in the preparation of glaze or coating suitable for covering stone, earthenware, plaster, furniture, and other surfaces."

2004. W. Thwaites, Brixton, Surrey, E. Fondeville and G. Bertin, Kentish Town, Middlesex, "Improved composition or admixture for preserving walls from dampness, and for other purposes."—Petitions recorded July 2, 1872.

2020. J. F. Stewart and H. Defty, Middlesbrough, Yorkshire, "Improvements in, and connected with, puddling furnaces."—Petition recorded July 4, 1872.

2033. J. Miller, Aberdeen, N.B., "Improvements in purifying and decolourising hydrocarbons."—Petition recorded July 5, 1872.

2614. B. W. Gerland, Macclesfield, Cheshire, "Improvements in the manufacture of phosphoric acid, phosphatic manures, alkaline and other phosphates."—A communication from H. Albert, and E. Albert, Biebrich, Germany.—Petition recorded September 3, 1872.

2717. W. S. Dixon, Grosvenor Place, Middlesex, "Improvements in the manufacture of plute iron or refined metal."—Petition recorded September 13, 1872.

2988. J. Young, Kelly, Renfrewshire, N.B., "Improvements in treating liquors containing ammoniacal compounds in order to obtain products therefrom."—Petition recorded October 10, 1872.

3008. W. Ferrie, Airdrie, N.B., "Improvements in applying combustible gases obtained from smelting furnaces, or from gas producers for heating puddling and other furnaces, and in apparatus connected therewith."—Petition recorded October 12, 1872.

3094. E. C. Nicholson, Herne Hill, Surrey, "Improvements in the production of colours for dyeing and printing."

3095. A. P. Price, Lincoln's Inn Fields, Middlesex, "Improvements in the treatment of substances capable of being employed for the purposes of dyeing and printing."—Petitions recorded October 19, 1872.

PATENTS SEALED.

1466. E. G. Brewer, Chancery Lane, Middlesex, "Improvements in the manufacture of steel, steely iron, and homogeneous metal, and in apparatus therefor."—A communication from F. G. Bazault, and I. J. Roche, Paris.

1469. G. Bedson, Manchester, "Improvements in puddling furnaces."—Dated May 14, 1872.

1521. C. Herveux, Islington, Middlesex, "Improvements in tanning and in apparatus used therefor."—Dated May 18, 1872.

1604. R. Irvine, Leith, N.B., and J. Mackintosh, Buenos Ayres, Argentine Republic, "Improvements in the manufacture of paper stock."—Dated May 27, 1872.

1739. F. G. Morton, Bermondsey, Surrey, "An improvement in utilising tin-plate scraps or clippings, and in separating the tin and iron contained therein."—Dated June 8, 1872.

1876. S. B. Smith, Birmingham, and J. W. Willans, Middlesbrough, "Improvements in the process of, and apparatus for, smelting iron ores and other ores, and re-heating iron and other metals, parts of which improvements may also be applied to other purposes"—Dated June 21, 1872.

2450. F. Lipscombe, Strand, Middlesex, "Improvements in the treatment of noxious vapours, and in apparatus or appliances in connection therewith."—Dated August 16, 1872.

2518. W. Lochhead, Glasgow, N.B., "Improvements in treating asbestos or amianthus, and applying the same to various useful purposes."—Dated August 24, 1872.

2786. P. P. F. Micheá, Jubbulpore, East India, "New substances for dyeing, printing, and tanning, and the process employed for treating one of such substances."—Dated September 20, 1872.

FOREIGN PATENTS.

SWEDEN.

1. W. Riddell, "Improvements in the manufacture of paper pulp, and apparatus for cutting wood."

12. D. Schröder, "Improvements in his mode of obtaining lighting and heating gas from peat or sawdust."

13. T. Foldberg and E. Nielsen, "Improvements in the manufacture of starch."

14. J. E. Sherman, "Improvements in the manufacture of iron and steel."

21. J. Erichsen, "A mode of obtaining paint."

37. H. Gahn, "A compound or mixture called 'amykos.'"

47. A. P. Sjöberg, "Obtaining grease or oil from distilled resin for lubrication."

49. D. A. Lyfe, "Improvements in heating and preparing substances for the manufacture of paper, and in processes for bleaching other materials."

52. A. R. P. Smith and C. W. Granville, "Improvements in obtaining paper-pulp of wood."

64. A. Ohlsen, "Manufacturing press-yeast of beer-yeast."

66. A. Deininger, "A mode of, and apparatus for, preparing sundry plants for paper-making and spinning."

71. L. E. Bowman, "A reverberatory furnace for smelting copper, lead, and nickel."

73. H. R. Fanshawes, "Improvements in the treatment of hides and skins in tanning, and otherwise utilising all portions or pieces thereof, and in the treatment of goods already tanned."

75. C. J. Schmiedte, "An apparatus for the manufacture of concentrated manure of human excrements, or so-called 'super-phosphate of cess-pools.'"

76. H. Searle and C. Eskrett, "A kind of oil-cake."

85. T. E. Petersen, "A salve for preventing the incrustation of steam boilers."

86. B. Tanner, "Improvements in the manufacture of superphosphate of lime."

87. A. G. Southby, "Improvements in operations for drying down alkaline solutions of extractive matter obtained in preparing vegetable fibrous materials for use in the manufacture of paper, and in recovering alkali therefrom for re-employment."

90. F. W. Colls, H. Atkinson, J. J. Michael, and T. W. Knight, "Improvements in preparing pulp from wood and other fibrous substances for making paper, papier mâché, and other analogous manufactures."

94. W. Riddell, "A process and apparatus for disintegrating, softening, washing, and bleaching wood, straw, esparto grass, and other vegetable fibres, and for extracting resin, silica, or other substances therefrom."

97. T. C. Hinde, "Improvements in the manufacture of iron and steel."

98. J. A. Zee, "Improvements in obtaining paper-pulp of wood."

106. O. Beckman, "Obtaining so-called 'malt coffee.'"

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PROFESSOR MAX MÜLLER, LL.D. Three Lectures. "On Darwin's Philosophy of Language." On Saturdays, March 22 and 29, and April 5.

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PROFESSOR TYNDALL, LL.D., F.R.S. Six Lectures. On Thursdays, April 24 to June 5.

PROFESSOR ODLING, M.A., F.R.S. Four Lectures. On Saturdays, April 26 to May 17.

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THE CHEMICAL NEWS.

VOL. XXVI. No. 679.

NEW FACTS ELUCIDATING OUR KNOWLEDGE OF THE THEORY OF FERMENTS, PROPERLY SO-CALLED.

BY M. L. PASTEUR.

I HAVE for a considerable time considered fermentation (properly so-called) to be a chemical phenomenon correlative with physiological actions of a peculiar nature, and I had previously proved that the ferments which excite fermentation are not dead albumenoid matters, but living organisms. I have induced the fermentation of sugar, lactic and tartaric acid, and glycerine, in fact all kinds of fermentation, in mediums exclusively mineral, thus affording incontestable evidence that the decomposition of fermentable matter is correlative with the life of the ferment, so that it is one of its essential foods. For instance, under the conditions just alluded to it is impossible that there should be, in the constitution of the ferments which are generated, a single atom of carbon which is not derived from matter suitable for fermentation. The chemical phenomena of fermentation are distinguished from many others, and more particularly from those of the acts of life in its ordinary sense, by the fact of the decomposition of a far greater weight of fermentable matter than that of the ferment in action. I have long thought that this particular character is related to that of nutrition without contact of free oxygen. Ferments might therefore be considered as living beings, but endowed with a life, *sui generis*, in the sense that they possess the property of accomplishing all acts of life, procreation inclusive, without in any way requiring atmospheric oxygen. The mind here recurs to those singular infusoria which induce butyric or tartaric fermentations, or certain putrefactions, and which not only live and multiply without oxygen, but are even killed and cease to induce fermentation as soon as oxygen gas is dissolved in the liquid, or soft semi-solid substance, in which they live. By direct experiments made with beer-yeast I have found that, if the life of that very small cellular plant were partly dependent upon oxygen, it would, according to the proportion of intensity of that influence, partly lose its character of ferment; that is to say, the weight of yeast formed under these conditions during the decomposition of the sugar would gradually become greater, and approximate to the weight of decomposed sugar when gradually the life of the yeast plants continues to linger on in the presence of increasing quantities of free oxygen. Guided by these facts, I have been led to consider fermentation as a *conditio sine qua non* of the manifestation of life, when that life exists beyond the direct combustion due to free oxygen gas. As a consequence of this theory, we may consider that every being, every organ, every cell, which lives, or can continue to live, for any length of time, either without any atmospheric oxygen at all, or only in a very limited proportion, for its whole existence, is to be regarded as possessing the character of a ferment in reference to the substance which supplies it either wholly or in conjunction with heat. This substance must of necessity be oxygenated or carbonated, since, as already stated, it yields food to the ferment; because all *fermentescible* substances contain these two elementary substances. Let us take, for instance, a saccharine liquid, suitable for the food of ferments, and place it in a vessel in such a manner that we can put into that liquid any special organised production, so that no other organisms can afterwards, unknown to the experimenter, betake themselves spontaneously—that is to say, germs suspended and floating about in the air—into the same liquid. Upon that liquid let us place a trace of pure *mycoderma vini*, and we shall find that after a few days the surface of the liquid is covered with mycoderma, in the shape of a thin, but continuous film, and that the development of the mycoderma under these conditions gives rise to absorption of atmospheric oxygen, which is replaced by carbonic acid, while, on the other hand, no alcohol is formed.* Let us repeat this experiment, under precisely the same conditions, and, when the film of mycoderma is fully formed, let the vessel be so shaken about that the film is as much as possible submerged, because the fatty matter adhering to it prevents its becoming readily moistened and totally submerged; and we shall find that on the next day, or even in a few hours, if the vessel and contents are kept at from 25° to 30°, small gas bubbles are evolved from the bottom of the vessel, proving that the alcoholic fermentation has set in. This continues for some days, although weakly, and it is easy to obtain from the liquid perceptible quantities of alcohol. Microscopic examination of the submerged cells of the mycoderma proves that they are not reproduced, but that they become swollen and the interior structure of their plasma greatly altered. If the fermentation ceases, it can be again set in action by causing the freshly-formed film of mycoderma to be submerged afresh in the saccharine liquid.

The interpretation of these facts is not difficult, because we see in these comparative experiments cells which, at the desire of the operator, become ferments or cease to be so. The question arises, What is the difference in the condition of existence of the cells of the *mycoderma vini* in each of these cases? In the first, the life of the plant on the surface of the liquid continues and is kept up by the atmospheric oxygen; while, in the other case, that life continues and is sustained beyond, and without the influence of oxygen, or at least under the influence of a very small quantity only of that gas, because that which may have become dissolved in the fluid is retained by the living cells left on the surface of the liquid. That life is not extinct in the submerged cells is proved by microscopic research, as well as by the fact that the cells induce fermentation. I will not speak here of a case in which the sporules placed upon the surface of the liquid produce real beer-yeast, because I shall have another opportunity of returning to that subject. We see, in this double experiment, on the one hand, the life or multiplication of cells, with absorption and assimilation of free oxygen, and formation of a corresponding volume of carbonic acid; and, on the other, the continuation of the life of a portion of these cells when submerged, and without the aid of oxygen gas, but with the correlative appearance of alcoholic fermentation, that is to say, a continued evolution of carbonic acid gas and production of alcohol.

It is rather curious that similar experiments made by me succeed with ordinary mouldiness; the *Penicillium glaucum*, for instance, which lives in contact with free oxygen, and takes up as much of it as it can consume for the purpose of accomplishing all the acts of its nutrition and rapid development, does not produce alcohol at all, but as soon as this cryptogamic plant is deprived of oxygen, and submerged under a liquid fit for the production of the phenomena of fermentation, its character changes entirely, and this change is accompanied by the production of alcohol and carbonic acid precisely in proportion to the duration of the acts of nutrition of the plant under its new condition of existence.

Beer-yeast, that type of ferments, and the other organised ferments which I have discovered, may therefore be con-

* I have previously said that the mycoderma has two modes of living (existence)—that is to say, that it is either mouldiness or ferment, according to circumstances—and that the beer-yeast of so-called bottom fermentation is no other body than mycoderma, which is converted into that yeast when deprived of the contact of atmospheric oxygen. I ought also to observe that the phenomena which characterise this conversion are rather complicated, but that I shall soon be enabled to give all the particulars of it. I am bound to make this observation here because I speak above of *mycoderma vini* in terms somewhat different from those here used.

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sidered as plants or animals which differ from lower living organisms in that the former are endowed with the faculty of living and multiplying, beyond the contact of air, regularly and for a prolonged period of time. I have reason to believe that the mystery of fermentation is explained and elucidated by the results just alluded to.

By organised ferments we mean such organisms as are capable of continuing their existence, and of multiplying without the necessity of free oxygen for the purpose of burning and setting in action the materials of their nutrition; organisms, in other words, which can directly assimilate oxygenated matters capable of supplying heat by their decomposition, such, for instance, as sugar. Viewed in this light, fermentation appears to us as a peculiar case of a very general phenomenon; and we might say that all living beings are ferments in certain conditions of their lives, because there do not exist any in which momentarily the action of free oxygen could not be suspended. Let any living being be killed by asphyxia, by section of nerves, &c., or let any organ in such a being be deprived of life, the consequence is that since physical and chemical life cannot be instantaneously extinguished it will continue, and if that happens with privation of free oxygen (interior or exterior), then the being, the organ, the cells, will forcibly take the heat they require for their new acts of nutrition or for change in their tissues from the materials by which they are surrounded. From that moment they will decompose those materials, and we shall see the proper character of fermentation appear if the quantity of heat developed corresponds to the decomposition of a weight of fermentable matter perceptibly larger than the weight of materials set in action by the living being, by the organ, or by the cell.

The following facts appear to me to be the logical deduction of these principles. Dr. Bérard has told us (in a published memoir) that when fruit is placed in air or in oxygen gas in an enclosed space, a certain volume of that gas disappears, and an almost equally large bulk of carbonic acid gas is substituted for it. When the fruit is placed in a similar manner in carbonic acid or any other inert gas, a very perceptible quantity of carbonic acid gas is still formed, as if, says Dr. Bérard, it were developed by a kind of fermentation.

The following is, to my view, the interpretation of these facts. When fruit or any organ whatsoever is separated from the plant or from the animal of which it formed a part, life is not at once extinct in the cells which are component portions of such fruit or part of animal. The ripening of fruit after having been gathered is a palpable proof; if air is present, oxygen intervenes and plays a part in the changes which take place in the interior of the fruit. The heat is derived from the combustion which is the result, and in which the sugar plays a great part; but in that case there is no difference between the nutrition then taking place and that which occurs when the fruit is still upon the tree, and is characterised by living beings by this, that the weight of the materials transformed or set in activity is comparable to that of the materials which serve the purpose of food. It is clear that under such conditions no alcohol nor carbonic acid can be formed, except accidentally, any more than when the *mycoderma vini* lives with a supply of free oxygen.

In these conditions for every volume of carbonic acid produced a nearly equal volume of oxygen is consumed; it is in fact, ordinary respiratory combustion. Let the fruit be placed in an atmosphere of carbonic acid, and it will be found that life continues by taking from the decomposition of the sugar the heat it requires for its sustenance. The cells are then in the condition of those of ferment which live beyond free oxygen, as is the case with the cells of *mycoderma vini* when submerged. Almost as soon as fruit is placed in carbonic acid, alcohol is formed along with that gas, and although the quantity of it be small it is quite apparent; for in my experiments, *24 plums* gathered from the tree and placed in carbonic *acid gas yielded after* a few days 6·5 grms of absolute alcohol, while the fruit had not undergone any change, but was quite sound. A corresponding quantity of sugar had, of course, disappeared. 24 plums of the same sort, left in contact with air, had become soft watery, and very sweet. Grapes, melons, and all fruits containing acids behave in the same way. A rhubarb leaf placed in an atmosphere of carbonic acid gas gives off, after 48 hours, a somewhat vinous smell, while the leaf apparently is not at all altered, and it yields, on distillation, small quantities of alcohol. I am certain that when the operations are carefully conducted, no beer yeast nor any other ferment is formed. It is only in rare and exceptional cases that ferment cells can penetrate into the interior of fruit. Grapes deserve particular attention in this respect. Everyone may have observed that during the time of wine-making the juice of the freshly pressed grapes, and even the fruit itself, when taken from the tubs, taste and smell quite differently from grapes eaten from the stalks. It is thus with grapes kept in carbonic acid gas for some time. On being taken out of that gas, they have precisely the same taste and smell as fruit in the press-tub. This is due to the fact that during the wine-making the grapes are suddenly plunged into an atmosphere of carbonic acid.

I have no doubt the study of the phenomena here alluded to, when applied practically to the gathering of grapes, might become useful for the art of wine-making, and I should not be surprised if, by preserving bunches of ripe grapes in an atmosphere of carbonic acid, it were possible to prepare specialities of wine and brandy which would be highly valued in commerce.

I have not had time to study these points of view in animal organs. It is probable that the phenomena may differ from those exhibited by vegetable cells. Very likely the equations of all these fermentations of a new species will differ not only with every kind of cell, be it animal or vegetable, but in each instance, according to their proper nature. The few experiments made by me upon organs of the animal kingdom are too incomplete to be spoken of here, but I believe that—reasoning from the results obtained—a new view will be for physiology and pathology, and I hope that much light will be thrown on the phenomena of putrefaction and gangrene, while the production of putrid gases beyond the reach of organised ferments will receive an equally sound explanation as the formation of alcohol and carbonic acid beyond the presence of cells of alcoholic ferment.—*Comptes Rendus.*

ON OXY-AMMONIAS AND PHOSPHINE BASES.

By SAMUEL E. PHILLIPS.

The recent and valuable researches of Hofmann on the oxidation of phosphine bases necessitate a re-examination of the many disjointed facts which confuse the literature of chemical science. The isolated aspect of Hofmann is one of numerical ingenuity, but that the radicals of nitric acid or phosphinic acid consist of NO_2, or PO_2, are points of the very slenderest hypothesis.

In writing a paper on the amides some 20 years ago, we contended that they were *intermediate* between the basic ammoniums on one side and acid ammoniums on the other, and that the latter rose in the electro-series, and were more definitely acid in proportion as the radical replacements of H were more negative or acidifying.

It was then contended that "acid + ammonia − 2HO = the amide;" while "2 of acid + ammonia − 4HO = the aminic acid." Since then a fertile extension of this generic law has opened up in the kindred formula, "alcohol + ammonia − 2HO = a basic amine," of which the sugar-salt of M. Bouchardat is a recent illustration; "glucose + ammonia − 2HO = glucosamine" (like the glucosaniline of M. Schiff). The platinum salt is—

$$(C_{12}H_{11}O_{10})H_3NCl + PtCl_2$$

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The obstinacy of Berzelius in admitting that Cl might replace and function to some extent the positive or basic H has been felt in my own case, in regard to the more exceptional replacement of H by O. Meanwhile, the facts typified in hydroxylamine have slowly accumulated until the crowning and brilliant researches of Hofmann have prompted this review.

Before proceeding to minutiæ, it may be well to offer an open breast and pay still further homage to the new school of thought in the admission that hydroxyl (HO_2) may, peradventure, in some weak and inconspicuous instances, function as a radical and replace one H.

The botanist wisely discriminates between normal types and monsters, and it would be well if a like logical care were evinced in chemical philosophy.

The fixation of 2 or more atoms of O in organic radicals is typical of the negative hydrocarbons, and is far more exceptional in those which have a larger proportion of H.

The hydrocarbon of acetic acid is normally ($C_4H_3O_2$), and is exceptionally (C_4H_3); just as that of alcohol is normally (C_4H_5), and exceptionally ($C_4H_5O_2$).

Admitting that ($C_4H_5O_2$) or (EO_2) and ($C_2H_3O_2$) or (MeO_2) may function as radicals, and replace one H, it may be possible that in a more exceptional case (HO_2) may do so likewise. This cautious admission, however, should in no way justify the curious and frequent use made of hydroxyl, and much less of potassoxyl (KO_2). We stay not here to consider the paucity of evidence, or the intense unlikelihood of such dispositions of atomic force, nor can we enter upon the tempting subject of polyamines or condensed ammonias. The outset or first stage of that action is, however, of so common a character, and enters so largely into ordinary chemistry, that we cannot pass it over without a few remarks.

Ammonia ordinarily exists in two forms, each of which has it hydride or non-combining characteristic, and each has its combining function as a base or an acid. The hydride forms are typically $H_3N=17$ and ~~H_3N~~, or $(H_6N_2)=34$, both ordinarily 2 vols. One is ammonia, and the other may be called atmonia. I say typically, because atmonia in its simplest form is as yet hypothetical, though its forms abound in every manual of the science.

A confused assemblage of modern types subsist by which atmonium forms consist of 8H elements, or their equivalents, and the erroneous assumption is, that the hydride combines with two atoms of acid, as contra-distinguished from a simple ammonia which combines with one only.

The simple truth is the opposite of all this; for whereas ammonium $=4H$ to one N, so atmonium typically consists of 7H to two N; and as both affect the same volume, so both unite similarly with *one* atom of acid to form compounds of similar types, and similar general properties. This confusion is well exemplified in a paper on the platinum compounds by Professor Odling (CHEMICAL NEWS, vol. xxi., p. 289). Comparing ethylamine with ethylenamine, he tabulates the distinction thus:—

Monamine Type.		Diamine Type.	
KCl	$(4)N,Cl$	$BaCl_2$	$8N_2'',Cl_2$
KHO ..	$(4)N,HO$	$Ba(HO)_2$.. ..	$8N_2''(HO)_2$

The *true* chloride of ethylenamine would be $(7)N_2Cl$, strictly comparable with the ethylamine chloride. The above bichloride (?) the so-called "hydrochlorate," is the chlorhydrate of ethylenamine, $(7)N_2Cl+HCl$; like the—

Hydrate of ammonium, $(4)NO+HO$
Hydrate of ethylenamine, $(7)N_2O+HO$,
The crystallised hydrate, $(7)N_2O+3HO$

Whether the barium chloride is better notated as $BaCl_2$, and the hydrate $Ba(HO_2)_2$, or as I should prefer it, BaCl and $BaO+HO$, involves a wide question of diatomic philosophy which I am anxious to avoid in this connection; hence my numerical or typical representations.

The Professor says, "The double ammonia (ethylenamine) combines with 2 atoms of hydrochloric acid to form the definite hydrochlorate." Precisely; but the same necessity equally exists with the simple ammonia! In either case 1 atom of acid forms the chloride, and 2 atoms yield the chlorhydrate, and similarly with the oxide and hydrate.

Nobody contends that the condensed or di-acids combine with 2 atoms of base, or that the di-alcohol, or di-glucoses replace 2 of H; and yet they are directly comparable with the double ammonias or *diamines*.

For every chloroplatinate of ammonium, $(4)NCl+PtCl_2$, we have a corresponding platinate of atmonium—

$$(7)N_2Cl+PtCl_2.$$

Urea is a di-carbamide, yet we know that the acetate is normally $(7)N_2O+AcO$, or $(CO)_2H_5N_2O+(C_4H_3O_2)O$.

Similarly M. Gentz gives us di-xylyl guanidine, $(C_{16}H_9)CyH_3N_2$, and the platinate salt—

$$(C_{16}H_9)CyH_4N_2Cl+PtCl_2.$$

M. Cahours and Gal give chlorides of both ammonium and atmonium.

Chloride of gold arsine	E_3AuAs,Cl
,, ,, palladium arsine ..	E_3PaAs,Cl
,, ,, platinum ,, ..	E_6PtAs_2,Cl
	$Me_3PtAsCl.$

Hoping that these preliminary remarks may have cleared the way, we proceed to a brief glance at the oxy-ammonias; and first among these stand the hydroxylamines of M. Lossen.

Hydroxylamine	$H_2(HO_2)N$
Di-ethylamine..	$E_2(HO_2)N$
Di-benzylamine	$(C_4H_5O_2)_2(HO_2)N$
Tri-benzylamine	$(C_{14}H_5O_2)(C_{14}H_5O_4)N$
Hydroxamylene ammonia ..	$H_3(C_{10}H_{11}O_2)NCl$
By abstraction of 2HO	$H_3(C_{10}H_9)NCl$
Hydroxethylen tri-ethylamine	$E_3(C_4H_5O_2)NCl$
Chloroplatinate ,, ,,	,, ,, $NCl+PtCl_2$
Chloroaurate	,, ,, $NCl+AuCl_3$
Hydrate .. .. } Homologue of choline .. .. }	,, ,, $NO+HO$
Hydroxylamine urea	$(CO)_2H_3(HO_2)N_2$
Chlorhydrate ,, ...	$(CO)_2H_4(HO_2)N_2Cl$
Semi-chlorhydrate of hydroxylamine	$H_5(HO_2)_2N_2Cl$
Sesqui-chlorhydrate of hydroxylamine	$H_7(HO_2)_3N_3Cl+HCl$

These are culled from various memoirs given during the last few years; and the names, types, and ideas involved, are certainly grotesque. But it is not a little remarkable that they all, without one exception, conform to the principles of an older and simple chemistry, which is now seen adequate to comprehend the most exceptional cases of modern research.

As to the homologue of choline, the type is perfectly *identical* with the glycol-ethylamine produced by M. Wurtz, who found it to be identical with the *choline* of liver, or the *neurine* of brain.

Next come the antimony and arsenic bases, and their oxyaminic acids, of which I have by me just now only the slender enumeration of Lowig.

The methyl-arsine, Me_3As, would seem strictly analogued by Hofmann's Me_3P. Of the ammoniacal forms Me_4As, and their oxides and chlorides, and corresponding salts, we say nothing here as they are so simple and well known. The Me_3As affects 2 vols. like the corresponding Me_3N, or H_3N, &c.

Lowig gives methyl, ethyl, and amyl forms of these bases, and lays stress on the peculiarity (?) that whereas the tetra forms (ammonium) combine with 1 O.Cl.S, &c., the tri forms (ammonia) combine with 2 atoms. Of course they do, to the production of the combining ammonium type; and methinks a fuller development would exhibit hydroxylamine varieties. Speaking of the oxide he says, "It behaves like an inorganic bar

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and with acids gives soluble crystallisable salts," $Me_3OAsO+2HO$, &c.

The antimony bases are doubtless strictly parallel, but a confusion subsists with kakodylic acid, and probably hydroxymaline varieties. That (H_2N) is a radical, replacing 1 H, is generally admitted; but whether it combines with elements atom for atom is not so clear. The corresponding E_2P, or Me_2As, do so combine, and give us oxides, chlorides, or sulphides! The oxide of kakodyl, Me_2As, "is a real base, and combines with acids to form crystallisable salts." Kakodylic acid is best regarded as an oxaminic acid, and, like the corresponding phosphinic acid, "it resists the action of the most powerful reagents."

The sulpho form is equally definite with sulpho bases, and there is a corresponding chloro type—

$$Me_2O_2AsO+HO$$
$$Me_2O_2AsS+HS$$
$$Me_2O_2AsCl+HCl, \&c.$$

Lastly come the phosphine series of Professor Hofmann. Chemists will very highly appreciate his refined and beautiful improvements in the production of phosphine bases, but these products are too simple and well-known to occupy us in this connection. At the outset of this comparison, however, a great difficulty subsists in the italicised statement that the oxidised tri-methyl phosphine "is no longer capable of forming saline compounds;" whereas we have seen that the corresponding arsine "behaves like an organic base." Whether viewed as a simple oxy-ammonium, or as a possible hydroxylamine variety, in either case we think it ought to dedouble in weakly saltic forms, and thus destroy the numerical symmetry of the Hofmann series.

The great step involved in the easy production of the mono- and di-phosphines is stated with much force and interest. The formula of production, so well put, is, however, further simplified by omitting unnecessary diatomic doubling.

Primary Phosphines.

(E = Ethyl or other radical.)

$$E_1+H_4P_1+ZnO = EH_3P_1 \text{ and } Zn_1 \text{ and } HO.$$

Secondary Phosphines.

$$2E_1 + H_4P_1 + 2ZnO = E_2H_2P_1 \text{ and } 2ZnO \text{ and } 2HO.$$

Tertiary Phosphines.

$$3(EO+HO) + H_4P_1 - 6HO = E_3HP_1 \text{ and } 6HO.$$

Quaternary Phosphines.

$$4(EO+HO) + H_4P_1 - 8HO = E_4P_1 \text{ and } 8HO.$$

The first of these is described with much interest, and the chloride, iodide, sulphide, sulphate, and chloroplatinate are spoken of—

$$MeH_3PCl$$
$$MeH_3PCl+PtCl_2$$
$$MeH_3PO+SO_3, \&c.$$

The second evinces a still greater tendency to oxidation than the first; however, it easily unites with acids to the production of crystallisable salts, just as we have seen with Lowig's arsine analogues. The chloroplatinate is $E_2H_2PCl+PtCl_2$. But the main interest attaches to the oxidation of these bases; I give a comparative list:—

Hofmann.		Phillips.
H_3P fixes $4O$ and $= HO, HO, HO\}PO$	$=$	$O_4P,O+3HO$ (Phosphoric acid.)
EH_2P ,, $3O$,, $= CH_3, HO, HO\}PO$	$=$	$MeO_3PO+2HO$ (Methyl-phosphinic acid.)
E_2HP ,, $2O$,, $= CH_3, HO, HO\}PO$	$=$	Me_2O_2PO+HO (Dimethyl-phosphinic acid.)
E_3P ,, $1O$,, $= CH_3, CH_3, CH_3\}PO$	$=$	$Me_3OPO+HO_3$ (Tri-methyl-phosphinic oxide.)
To this I add E_4P *fixes* $1O$	$=$	$Me_4PO+HO.$

The stabillty of the first is striking when compared with the isomeric and weakly "methyl-phosphorous acid (phosphide of methyl), $MeO,2HO+PO_3$; but how may we analyse its typical character with data so vague as the following. The lead salt is given "$(CH_3)PtPO_3$, or perhaps more correctly $(CH_3)_2PtP_2O_6$. Analysis showed the barium salt to be $C_2H_6BaP_2O_6=(CH_3)_2H_2BaP_2O_6$!" I believe these two salts to be—

$$\text{Lead salt, } 2PbO+MeO_3P,O$$
$$\text{Barium salt, } 2BaO+MeO_3P,O.$$

The second is evidently monobasic; it is well and clearly defined, and corresponds with the analogues described by Lowig:—

Silver dimethyl-phosphinate	$= Me_2O_2PO+Ag0$
Potassium dimethyl-arseniate	Me_2O_2PS+KS, &c.

The third body we have referred to as anomalous, and we unhesitatingly predict for it a weak saltic dedoublement; and if so, the hydrate would complete my series.

Hofmann speaks of the typical representative of his series as "tribasic ortho-phosphoric acid"; whence it follows, if the notation has any meaning at all, that the ordinary acid is PΘ, with 3 atoms of hydroxyl base, that the fourth is the same with 3 atoms of methyl base, and intermediately with the others; but how ill this accords with the facts is well seen by my representation of the facts.

The typical acid is a pure oxy-acid, and combines with 3HO, 3KO, or 3MeO, &c.

The first derivative is a "methyl-phosphoric acid," which combines with 2 atoms of HO, KO, MeO, &c. The third would be a tri-methyl acid were it not too basylous; replace the 3 atoms of Me by a more negative hydrocarbon, and it would be weakly acid, or with 1 H it is distinctly basic, while with 1 O it is equivocally intermediate.

In so far as my types represent *these facts* they are independent of any theory, and *absolutely true*.

As modern chemists will persist in the prolific multiplication of hybrid details with an impetuosity which disdains the higher study of the unity and simplicity of law, I feel bound to give a reluctant glance at a few of the modern memoirs in connection herewith.

M. Michaelis (Chemical News, vol. xxv., p. 57), gives some varied phosphine chlorides:—

$$Cl_4P,Cl$$
$$Br_2O_2P,Cl$$
$$Cl_2O_2P,Cl$$
$$Br_2Cl_2P,Cl$$
$$S_2BrClP,Cl$$
$$(C_4H_5S_2)Cl_2P$$
$$(C_4H_5S_2)_3P$$
$$(C_4H_5O_2)_3OP,S.$$

As S is a very unusual constituent of ammonia, I give a few from M. Merz and W. Weith (Chemical News, vol. xxiii., p. 299).

Aniline	$(C_{12}H_4)HHN$
Thio-aniline	$(125)SHN$
The chloro-platinate ..	$(125)SH_2NCl+PtCl_2$
The sulphate	$(125(SH_2NO+SO_4$
The oxalate	$(125)SH_2NO=C_2O_3$, &c.

Schutzenberger (Chemical News, vol. xxvi., p. 26) gives some alcoholic platinum chlorides—

$$(C_4H_5O_2)_3PtPCl+PtCl$$
$$(452)_3Pt_2H_5PN_2,Cl$$
$$(452)_3Pt_2H_5PN_2Cl+HCl$$
$$(452)_6PtP_2,Cl$$

And similar series with $(C_2H_3O_2)$.

Also "phospho-platinous chloride	$Cl_3PtPCl+PtCl$
,, platinic ,,	$Cl_6PtP_2Cl+PtCl$
,, platinous acid	$(HO_2)_3PtP_2Cl+PtCl$
,, platinic ,,	$(HO_2)_6PtP_2Cl.$

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M. Chevrier in the *Journal of the Chemical Society* gives some further variations:—

$(C_{14}H_5)H_5PtN_2Cl$
$(145)H_5PtN_2Cl+PtCl$
$(145)H_5PtN_2O+NO_5$
$(145)H_8PtN_3Cl+PtCl$
$(145)H_8PtN_3I+PtI$
$(C_4H_5)H_5PtN_2Cl$
$(45)_2H_9Pt_2N_4,Cl.$

M. Saillard (CHEMICAL NEWS, vol. xxvi., p. 23)—

$(C_{14}H_7)(C_4H_5O_2)_3H_2PtPN,Cl+PtCl,$
$(147)(452)_3H_2PbPNO+HO,$ &c.

It is curious to observe that the index plainly points to a future resolution into one large group of "ammonia combinations" of all the nitric and phosphoric acids, and their analogues.

Between these ammonia acids on one side, and the ammonia bases on the other, I see no line of separation or distinction whatever; and if we represent by X, oxygen or other negative constituent, and by M, hydrogen or the more basic metals, then it will be found that the same laws of type and constitution equally subsist throughout the − or + regions.

Just as X_2N is inic or combining, and X_3N non-combining, while X_4N is eminently inic, so the same laws subsist with (M_2N), M_3N, and (M_4N).

On the one side we have NO_2 and NO_4, the radicals of nitrous and nitric acid, and on the other the perfectly analogous substitutions with (H_2N) and (H_4N), while $(NH_2)H$ is hydridic or non-combining.

Just as the nitrous combinations are weak and slender as compared with the nitric, so the basic forms of (H_2N), are still more slender and inconspicuous.

As no amount of hydrid or unstable variety seems to satisfy the cravings of modern chemistry for new and abnormal forms of combination, so this view may be acceptable as indicating a new field in condensed nitric, phosphoric, and other acids.

We have nitric acid O_4NO+HO; why not di-nitric O_7N_2O+HO, or tri-nitric $O_{10}N_3O+HO$ analogous to the corresponding di-amine and tri-amine bases.?

Since writing the above, and looking round for phospho varieties, we observe in addition to the chloro-sulphide ammonias of M. Chevrier, with their alcoholic derivatives, the phospho-amides of M. Schiff and Dr. Gladstone.

The resolution of the former is plain and easy beyond measure; the latter are under investigation, and are full of interest and promise. They involve a new feature of amide (H_2N), ammoniacal substitution, and undoubtedly contain the very condensed phosphoric acids anticipated in the above paper.

ELECTRICITY OF PLANTS.

IN the *Sitzungsberichte* of the Bavarian Academy, Dr. Ranke has recently described some researches on this subject.

Our knowledge of animal electricity is in great part due to Du Bois Reymond, who showed that, while the life of tissues continues, electric currents pass through the organs according to definite laws, and in correspondence with the various phenomena of life. It was reasonable to expect that in plant organisms something analogous would be found to occur. The vital phenomena in the two cases are not qualitatively different; but, in the case of animal life, exchange of material stands out more prominently, and in the case of plant life, assimilation.

The electric current observed by Du Bois Reymond between a wound and the uninjured coating of a muscle is not to be understood as a true animal electricity. It arises from the heterogeneous nature of the wound-surface acting with greater electromotive force on the electrode applied to it.

Buff and Heidenhain observed a current on similar treatment of plants, and they rightly attribute it to the chemical and electromotive difference between the sap flowing in the wound and the water with which the uninjured surface is moistened for the other electrode. It has no connection with the process of vegetation.

Dr. Ranke, experimenting in this way, observed the wound-surface to be negative with regard to the uninjured surface, and he names the currents thus produced false currents.

Between uninjured parts of the longitudinal surface, or between parts not become very heterogeneous (through soiling with sap or otherwise) Buff observed no regular current, and Dr. Ranke's experiments confirm this. They do not, however, confirm Buff's other observation, that no regular electromotive action was to be observed between the internal parts of plants.

As to this latter point, it was necessary, in the mode of observation, to guard against the development of false currents from heterogeneities of surface: to see that the two electrodes were not unequally soiled by the escaping sap. For example, more of the fluid flows from a cross section than from a longitudinal section; hence, an electrode being applied to each, the action on one would be greater than that on the other. Another source of possible error lay in chemical heterogeneity, as, *e.g.*, if one electrode were applied to a part of the tissue having an alkaline reaction, the other to a part having an acid reaction, in which case currents (similar to the false) would be obtained. To guard against this, only those plants were taken in which no trace of a difference of reaction was observable. The petioles of *Rheum undulatum* proved serviceable in this respect.

Another point of importance was the fibrous structure. As in the electricity of animals, the electromotive action was observed where the fibres did not lie parallel to the longitudinal axis.

The pieces experimented with, then, were cylindrical pieces from the petioles of the *Rheum undulatum*, their longitudinal axis corresponding with the axis of the petiole; and they were terminated by two cross sections perpendicular to this axis. They were 2 to 3 c.m. length, and 0·5 to 1·5 c.m. diameter of section. The apparatus for measuring the currents was similar to that used by Du Bois Reymond in his experiments.

If a piece of the kind described was taken, and one electrode applied to the cross section, the other to any point of the uncut epidermis, the false current appeared, the cross section being negative to the other surface. If now the outer surface of the piece was removed by cutting parallel to the axis, and the electrodes were applied, one to the cross section, the other to the surface laid bare as described, there was in every case a current observed, the direction of which was from the surface of cross section to the other (through the wire); hence the reverse of the false current, and of the currents in muscles and nerves. This is the true plant current, the expression of the real electricity of plants; Dr. Ranke styles it the strong current, using in this and in other cases a terminology corresponding to that of Du Bois Reymond. By a further cutting of the piece, either perpendicular or parallel to the axis, the current at first sometimes increases, but it gradually becomes weaker as the process is continued.

Du Bois Reymond named an imaginary cross section in the centre of a cylindrical piece of animal tissue the equator, and a line through the middle of the cross section the axis. When he applied the electrodes to two points of the cross section, which were symmetrical to the axis, or to two points of the longitudinal section, which were symmetrical to the equator, there was no current. But if the points were not thus symmetrical, there was a current; in the one case, the point more distant from the axis being positive to the nearer; in the other, the point nearer to the equator being positive to the more distant. In plants, something quite analogous is observed, the dissection of the currents, however (named like those of

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Du Bois Reymond, the weak currents), being reversed. Thus, in the case of plants, where two unsymmetrical points are taken in the cross section, that which is further from the axis is negative to that which is nearer. And of two unsymmetrical points on the longitudinal section, that which is nearer to the equator is negative to that which is more distant.

Further, in pieces cut of a rhombic form, currents were observed analogous to those Du Bois Reymond observed in similarly cut muscles, from the acute to the obtuse angles; but in the plants the direction was reversed.

Another point of correspondence between animal and plant electricity is that the currents only appear during the life of the tissue. The reaction of tissues which show animal electricity is always more or less alkaline, or neutral. After separation of the tissue from the living body, an acid reaction is gradually produced, and when this has taken place the electromotive action disappears. The living tissue of plants, on the other hand, is generally more or less acid, and in the death of the tissue an alkaline reaction is produced, and then, also, the electromotive action is extinguished.

Dr. Ranke experimented with a large number of plants besides *Rheum*, and found in each case the same laws of electromotive action to hold good where the fibres were arranged parallel.

Experiments were also made with pieces in which the fibres were not parallel, as in the case of certain roots; and the normal electric currents were met with if the shape of the root did not depart very much from the cylindrical, was not very conical. If, for the point of application of an electrode on the longitudinal section, a part of the root was chosen at which the tissue branched off, this acted as a cross section, and the current might be reversed. The same remark applies to stems.

Dr. Ranke observes, in the conclusion of his paper, that the similarity which has been established between animal and plant electricity warrants us in applying to the latter, with certain modifications, Du Bois Reymond's molecular hypothesis of animal electricity. We may suppose the interior of electromotive parts of plants filled with small peripolar molecules embedded in a conducting substance, the axes of these (joining the poles of each molecule) being parallel to the axis of that part of the plant containing them. The theory of animal electromotors supposes each of the molecules to have two negative polar zones, and one positive equatorial. The law of plant electricity requires, on the other hand, for each of the molecules, two positive polar zones and one negative equatorial.

A. B. M.

MINERALOGY.

A COURSE of six lectures on the above subject is in course of delivery to working men only at the Geological Museum on Monday evenings, by W. W. Smyth, F.R.S., Lecturer on Mining and Mineralogy at the Royal School of Mines. The first lecture was delivered on Monday, Nov. 11th, and dealt principally with definite geometrical forms assumed by inorganic substances.

These, he said, are extremely multifarious and varied; but, as they are intimately connected with the internal structure of the substances, and with their optical and other properties, it becomes very necessary to make ourselves acquainted with the laws governing these forms if we would rightly understand the substances themselves. Some observations on these forms were made by the Ancients, but they never appear to have been led to generalise on the matter. An objection to the more general study of this subject is often urged in that perfect and regular crystals could only be seen and studied in large collections and in museums; but the lecturer showed that, even in this science, materials for common observation were at hand if people would only look for them. He admitted, at the same time, however, that there is a great advantage to be derived from first studying those regular and perfect forms before advancing to less regular and less distinct ones. As an example of the common occurrence of crystals, he instanced those large white finger-like masses to be seen in the stone employed in many of our London bridges, which are often mistaken for fossils, but which are really crystals of the kind of felspar known as "orthoclase." Again, in examining a piece of common granite carefully, besides crystals like the above on a smaller scale, other crystals of a darker substance may also be seen, together with some thin leaf-like pieces of a third substance having a strong lustre. These are crystals of the materials of which granite is formed, viz., felspar, quartz, and mica. In a piece of crystalline marble may be seen also numerous bright little crystals lying in all manner of positions. In all the above cases, the individual crystals are not fully developed, because, owing to their lying so close together, they have more or less mutually interfered with each other.

If the crystals have been formed under favourable conditions, they will always assume a definite form, from whatever part of the world they are obtained. Thus, a crystal of quartz or rock crystal was shown to assume the form of a hexagonal prism, terminated by a hexagonal pyramid; a crystal of beryl to have a hexagonal prismatic form, but terminated by plane faces. And as each individual substance always assumed the same form, with certain definite limits and modifications, a knowledge of these forms must necessarily be a great help towards determining the nature of any inorganic substance. The lecturer illustrated this by referring to a fine quartz crystal on the table, brought by a Cornish miner from Brazil under the impression that it was a large diamond. The diamond always crystallises in the octahedron and allied forms. Sometimes, as in the case of carbonate of lime, the modifications of the fundamental form are very numerous, in that substance amounting to twelve hundred, but all within definite geometrical limits.

There are several possible ways of describing a crystal, *e.g.*, the position of its faces might be referred to the walls and ceiling of a room, or of some figure surrounding them, or they might be referred to certain imaginary lines or axes drawn within them. The latter is the mode now generally adopted, and forms which are in external appearance quite distinct are capable of being grouped together by means of their axes. Thus the hexagonal prism and hexagonal pyramid agree in having a hexagonal middle section, and they both belong to a system characterised by having one upright axis and three equal horizontal axes intersecting at equal angles. By means of axes placed in certain positions, the rhombohedron, and the scalenohedron (bounded by twelve scalene triangles) might be referred to the same group. Similarly with the group to which the octahedron belongs (and of which that form is taken as the basis) in which the axes are all equal. If we imagine a triangular pyramid erected on each face of the octahedron, we shall get a figure with twenty-four faces, technically called the triakisoctahedron. The cube is derived from the octahedron by imagining a plane in each angle of that figure parallel to the two axes not belonging to that angle.

According to this method of grouping together crystals according to their internal axes, six groups or systems are distinguished:—

(*a*). *Cubical System.*—To which the cube and octahedron belong. Has three equal axes intersecting at right angles, one regarded as vertical, and the other two as horizontal.

(*b*). *Hexagonal or Rhombohedral System.*—Has one vertical and three horizontal axes, the latter making equal angles with each other and being equal among themselves, but shorter or longer than the vertical.

(*c*). *Pyramidal or Tetragonal System.*—Has axes like the cubical system, with the exception that its vertical axis varies in length, being sometimes longer and sometimes shorter than the horizontal ones.

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(*d*). *Rhombic or Prismatic System.*—All its axes are unequal, though, like (*a*) and (*b*), intersecting at right angles.

(*e*). *Oblique System.*—Characterised by three unequal axes, two in the same plane at right angles to each other, the third oblique to that plane.

(*f*). *Doubly Oblique System.*—In this all the axes are of unequal length, and make unequal angles with each other.

Under one or other of these groups of forms may be classed, not only all the crystallised substances found in nature, but also those artificial crystals produced in the laboratory of the chemist.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 21st, 1872.

DR. FRANKLAND, F.R.S., &c., President, in the Chair.

THE minutes of the previous meeting having been read and confirmed, the names of Messrs. Alfred Payne, George Combe Stewart, Robert Routledge, and George B. Beilby were read for the first time; and for the third time, Messrs. Arthur Willis and George Symington Grieve Paton, who were balloted for and duly elected.

The first paper, "*On the Standardising of Acids*," by W. N. HARTLEY, F.C.S., was read by the Secretary. Instead of the sodium carbonate usually employed for this purpose, the author prepares a solution of pure sodium hydrate from a block of metallic sodium cut from a bar of that metal, and which is weighed in a capsule made from two test-tubes having their lips cut off and inverted one within the other. The sodium is dissolved in alcohol and then diluted with water; as the strength of the solution thus obtained is known, it may be at once employed for standardising the acid.

Dr. FRANKLAND, in thanking the author in the name of the Society, remarked that everyone who had worked with standard solutions of acids had experienced the difficulty there was when employing sodic carbonate, owing to the carbonic anhydride preventing that sharp recognition of the point of neutralisation which was obtained when a solution of caustic alkali was used.

The next communication, "*On Anthraflavic Acid*," was read by the author, Mr. W. H. PERKIN, F.R.S., &c. After alluding to his former paper on the same subject, in which he had expressed his opinion that anthraflavic acid was an isomer of alizarine, a view since confirmed by Auerbach, he stated that, when anthraflavic acid is strongly heated, it yields a golden yellow sublimate having the properties and composition of the original substance, and that the product obtained on fusing anthraflavic acid with alkalies, and which Schunck supposed to be alizarine, produces very different shades with alum mordants from those obtained with the latter colouring matter.

On heating the acid with acetic anhydride to 160°, a new compound, *diacetyl-anthraflavic acid*—

$$C_{14}H_6O_2\begin{cases}(C_2H_3O)O\\(C_2H_3O)O\end{cases}$$

is obtained, which crystallises in very pale yellow plates, not unlike benzoic acid in shape, and which melt at about 228°. The corresponding *diacetyl-alizarine*, prepared in a similar manner from alizarine, crystallises in flat needles or plates, which melt at about 160°, and are more soluble in alcohol and glacial acetic acid than diacetyl-anthraflavic acid. Anthraflavic acid, treated with benzoylic chloride, yields *dibenzoyl-anthraflavic acid*—

$$C_{14}H_6O_2\begin{cases}C_7H_5O)O\\C_7H_5O)O\end{cases}$$

a crystalline substance, of a pale yellow colour, which fuses at 275°. It would appear from the researches of Liebermann and Auerbach, that not only does anthraflavic acid occur as a by-product in the manufacture of artificial alizarine, but another substance, *monoxyanthraquinone*, $C_{14}H_7O,HOO$, differing from it in being readily soluble in baryta water.

The PRESIDENT said he was sure the Members would agree with him in thanking their Secretary for the additional information he had given them on the subject of anthraflavic acid, although he questioned how far we were justified in calling the compound an acid, as, when the basic hydrogen is replaced by acetyl or benzoyl, it yields compounds which do not possess the properties of anhydrides, as they should do if it were a true acid.

Mr. PERKIN replied that he regarded the hydrogen as being more of an alcoholic nature, and that he had merely retained the name of anthraflavic acid originally given to it by Dr. Schunck.

Dr. DEBUS asked whether the author could suggest any rational formula for the substance, or any combination of atoms which would show the nature of the substance.

Dr. ARMSTRONG observed that it was probable that the sulpho-acids obtained from anthracene for the preparation of alizarine were a mixture of isomeric acids, from one of which the anthraflavic acid was derived. Naphthalene and phenol, as is well known, yield isomeric sulpho acids.

Mr. PERKIN replied that the sulpho acids employed were certainly a mixture—both mono and disulpho acids were present, and probably also isomeric forms of the latter; but as yet he had not any process by which the anthraflavic acid could be directly prepared.

In reply to some observations by Dr. DEBUS on the internal movement of atoms which takes place when isomeric bodies change one into the other, Dr. ARMSTRONG remarked that, if this were the case, the change of place amongst the carbon atoms must be most extraordinary in some instances. For example, in the butylic series the alcohol—

$$\begin{cases}CH_3\\CH_2\\CH_2\\CH_2OH\end{cases}$$

when converted into the corresponding butylamine, and then into the nitrate, yields the secondary alcohol—

$$\begin{cases}CH(CH_3)_2\\CH_2OH\end{cases}$$

and from this, again, by a similar process, we obtain the tertiary alcohol—

$$C\begin{cases}CH_3\\CH_3\\CH_3\\OH\end{cases}$$

These changes, however, pointed to a method of great importance by which it was probable we might generate many new compounds. Each of these butylic alcohols had a lower boiling-point than that from which it was derived. Might not the amylic alcohols, if treated in a similar manner, yield the whole series?

Dr. DEBUS said that, if an organic compound went through a series of changes, it was assumed that the end product contained the same nucleus as that from which we originally started. Although this was generally true, it was not by any means a universal proposition, for there was a strong body of evidence to show that the nucleus sometimes underwent change.

The PRESIDENT said, the supposition that the atoms do not move in a compound must be received with caution, although it was true that some organic compounds might be treated with the most powerful reagents, and still retain their original form. The amylic alcohol, which causes a deviation of the plane of polarised light, was of this class; even boiling with sulphuric acid and acid potassic chro-

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mate did not cause it to lose this property, which was also possessed by all its compounds, so that we may assume it does not change, as its effect on light remains the same.

Dr. Armstrong remarked that the sulpho acid produced by treating it with sulphuric acid, and yielding the gummy barium salt, had no effect on polarised light.

Professor Williamson said that, in the present state of our knowledge, certain facts seem to establish a change in the nucleus which had hitherto been deemed impossible; and he agreed with Dr. Debus that, although there are numerous instances in which the nucleus is not affected, we now and then come across one in which a change appeared to take place, and the number of these was rapidly increasing.

Dr. Debus said that, when we consider inorganic compounds, we find great mobility amongst the atoms; but this was not the case with organic substances, in which the carbon atoms seemed to be so locked together, as it were, that there was no freedom of motion amongst them, and this property was extended to the other elements, such as chlorine and hydrogen, with which they happened to be in combination. For instance, sodium chloride gives a precipitate of argentic chloride with silver nitrate, but carbon chloride dissolved in alcohol does not give argentic chloride with silver nitrate, neither do the alcoholic chlorides, like chloride of ethyl. Under certain circumstances, however, such as increase of temperature, the force which held the atoms together became weakened, so that they became able to move with greater freedom and arrange themselves in new positions, forming new combinations.

Dr. Williamson desired to call the attention of the Members to a case of this which was well known to them all, that of bitter almond oil, a well defined and undoubted aldehyde, which, under the influence of alcoholic potash, split up into benzylic alcohol and benzoic acid. We are too prone to forget these well-established cases of change of position, and allow them to escape our notice. The fixity of carbon in organic compounds was unparalleled amongst inorganic compounds, and in this respect quite exceptional.

Dr. Frankland said that, in these internal movements of the atoms, the great matter of surprise was that the carbon atoms should change their places, and not that the other elements should do so.

The meeting then adjourned until Thursday, December 5th, when there will be two papers by Professor C. Rammelsberg, "On the Reducing Power of Phosphorous and Hypophosphorous Acids and their Salts," and "On Hypophosphites; also a paper "On New Analyses of some Mineral Arsenites and Phosphates," by Professor A. H. Church.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, October 29th, 1872.

Edward Schunck, Ph.D., F.R.S., Vice-President, in the Chair.

Dr. R. Angus Smith, F.R.S., described a remarkable fog which he saw in Iceland. It appeared to rise from a small lake and from the sea at about the same time, when it rolled from both places and the two streams met in the town of Reykjavik. It had the appearance of dust, and was called dust by some persons there at first sight. This arose from the great size of the particles of which it was composed. They were believed to be from $\frac{1}{100}$th to $\frac{1}{200}$th of an inch in diameter. They did not show any signs of being vesicular, but through a small magnifier looked like transparent concrete globules of water. They were continually tending downwards, and their place was supplied by others that rolled over.

Ordinary Meeting, November 12th, 1872.

J.P. Joule, D.C.L., LL.D., F.R.S., &c., President, in the Chair.

Charles Anthony Burghardt, Ph.D., and Henry Arthur Smith, F.C.S., were elected Ordinary Members of the Society.

"*An Account of some Experiments on the Melting-Point of Paraffin*," by B. Stewart, F.R.S.

The following experiments were made with the view of ascertaining—

(1). Whether the melting-point of different specimens of paraffin is the same.

(2). Whether that of the same specimen remains the same.

The method of observation adopted in these experiments was as follows. The thermometer had its stem fitted into the cork of a colourless glass flask so that when the flask was corked the bulb was in the centre of the flask, the extremity of the mercurial column appearing during the experiment slightly above the cork. The flask was kept heated to a point slightly below that of the melting-point of paraffin. The bulb of the thermometer was then dipped for a few seconds into some melted paraffin a few degrees above its melting point, and while covered with a fluid coating of paraffin was replaced in the centre of the flask. The flask being only a very little colder than the bulb, the cooling was then very slow.

The instrument was placed so that the reflected image of the bar of a window was seen distinctly in the mercury of the bulb through the liquid paraffin. One observer carefully scrutinised this reflected image by a lens, while another watched the downward progress of the column of mercury in the stem of the thermometer. As soon as the observer scrutinising the image observed a want of definition produced by incipient freezing, he noted the circumstance to his colleague watching the column, and thus the exact reading at which freezing began was ascertained. It was found easily possible to ascertain this point to one-tenth of a degree Centigrade. Four or five separate observations were generally taken, before each of which the thermometer was re-dipped into the melted paraffin.

In case of any change taking place in the zero of the thermometer while the experiments were in progress, the instrument was tried in melting ice before each experiment. The thermometer employed was a standard, constructed at Owens College, No. 3.

The coating of paraffin surrounding the bulb was sometimes kept from one experiment to another, being always carefully dried after the bulb was plunged in melting ice, and sometimes it was removed, but this circumstance did not appear to affect the results.

It was soon seen that different specimens of paraffin had very different melting-points, so that the research was directed to the second question, namely, whether the same specimen retains the same melting-point, after being frequently melted and solidified.

The following is a record of the various experiments made;—

1872.		
Feb. 29	..	Paraffin melted at 45·05.
Mar. 6	..	,, ,, (thermometer not observed).
,, 13	..	,, ,, at 44·90.
,, 21	..	,, ,, (thermometer not observed).
,, 26	..	,, ,, at 44·90
April 11	..	,, ,, (thermometer not observed).
,, 19	..	,, ,, (thermometer not observed).
,, 26	..	,, ,, at 45·00.
May 3	..	,, ,, (thermometer not observed).
,, 10	..	,, ,, ,, ,, ,,
,, 16	..	,, ,, at 45·00.
,, 23	..	,, ,, (thermometer not observed).
June 1	..	,, ,, ,, ,, ,,
,, 6	..	,, ,, ,, ,, ,,
,, 13	..	,, ,, at 44·90.

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The paraffin was melted without an observation of the thermometer at the following dates—June 19, 27; July 3, 19, 25; Aug. 1, 9, 16, 22, 31; Sept. 6, 14, 21, 27; Oct. 8, 17.

Observations with the thermometer were then resumed with the following results:—

Oct. 24	..	Paraffin melted at	44·60.
„ 31	..	„ „	(thermometer not observed).
Nov. 7	..	„ „	at 44·70.
„ 11	..	„ „	at 44·75.

The experiments now described have been made chiefly by Mr. F. Kingdon, assistant in the Physical Laboratory of Owens College. The most probable conclusion to be deduced from them appears to be that the melting-point of this specimen of paraffin has become somewhat lowered since the experiments began.

It is proposed to continue these experiments for some time longer; but in the meantime it has been thought desirable to describe the method of research, as this may be of interest to observers of melting-points.

CORRESPONDENCE.

MANUFACTURE OF SOAP.

To the Editor of the Chemical News.

SIR,—Kindly allow me space for a few remarks with reference to the paper on "The Analysis of Soaps" (CHEMICAL NEWS, vol. xxvi., p. 207), by Mr. J. Jean.

This gentleman makes a great mistake in classing resin amongst the fraudulent adulterations of soaps. Its employment in certain kinds is, beyond cavil, clearly insisted upon by the greatest number of consumers of the article. They will have soap so made, and no other. Enquiry of any one merely acquainted with the routine of a Soapery will suffice to prove this. Moreover, as I have been intimately associated with the practical details of the manufacture for twenty years past, I am enabled to add that this requirement as regards resin is simply a matter of fact. The demand for pale or yellow soaps—an indispensable feature of which is that they must contain from one-fourth to about one-third of resin—has existed for about a century past; and the call for these sorts, so far from diminishing, continues steadily on the increase.

In conclusion, allow me to add that about two years ago I solved the somewhat knotty problem as to the determination of the amount of resin in admixture with fatty matters in such soaps. This I can always effect in about one hour. Almost all the leading soap-manufacturers in England have been for some time in possession of the method, which I have only disclosed under a secret arrangement.—I am, &c.,

ALFRED G. ANDERSON,
Professor of Practical Chemistry in Queen's College, Birmingham.

146, Ladbroke Grove Road, North Kensington, W.,
November 26, 1872.

ODOURS OF PLANTS.

To the Editor of the Chemical News.

SIR,—I much appreciate Mr. Robert Mallet's remarks in your issue of the 15th inst. upon my previous brief communication concerning the "Utility of Odours to Plants in relation to Radiant Heat," but cannot quite understand whether the views to which he courteously refers as coinciding with my own were expressed only verbally or in manuscript to Professor Tyndall, or were published in any of the scientific journals. If the latter were the case, perhaps Mr. Mallet will kindly intimate in which of those periodicals they appeared.

Permit me also to observe that, although the question of quantity or "how much" is, as Mr. Mallet has remarked, an important one in most scientific speculations, still inability strictly to answer it does not always invalidate, or materially affect, our conclusions. In the case of odorous vapours, it must, too, be remembered that we are contemplating matter in, to us, an *imponderable* form, and that, therefore, any inferences relative to mere quantity must be extremely problematical.

I would, moreover, remind Mr. Mallet that, so far from the air in Professor Tyndall's experimental tubes having been "saturated in an odorous vapour," it was merely allowed to pass once over bibulous paper wetted with the different perfumes referred to in the lecture, and consequently the amount of the vapour taken up by it must, we may fairly conclude, have been as "infinitesimally small and unweighable as that which is sufficient to diffuse the perfume of the flower or fruit."

Perhaps the comparative loss of odour, mentioned by Mr. Mallet, in "the orange orchards of the South," may be attributable to the greater dryness of the air in those latitudes, and the consequent want of the great carrier of of vegetable odours—aqueous vapour.

If, however, the odour emitted be absolutely less in this and similar cases, the "heat jacketting" effects, on account of a higher atmospheric temperature, may be less needed by the plants in those regions.

Begging to thank you for the insertion of my preceding very imperfect observations,—I am, &c.,

W. H. OLLEY.

Stoke Newington, November 23, 1872.

MISCELLANEOUS.

The Chemical Prælectorship at Cambridge.—We are informed that Mr. J. Alfred Wanklyn has applied for this appointment. In the interest of Science we should be glad to see Mr. Wanklyn holding a chemical appointment.

London and General Water Purifying Company.—During the recent absence of H.R.H. the Prince of Wales from Sandringham, the London and General Water Purifying Company received orders to apply their system of filtration throughout the establishment, which they completed on Saturday last. It may therefore be considered that the danger arising from the former impurity of the water is now removed.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, November 18, 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Shape to be Given to the Standard Meters which the International Committee for Weights and Measures is about to get Constructed.—M. Tresca.—The author explains at length the reasons why the Committee determined to give to the standard meters a shape somewhat resembling an X; this shape exhibits by the smallest bulk of metal the greatest resistance, which exceeds 30 kilos. to the square millimetre; the lines indicating the divisions of the meter are to be engraved between the branches of the X.

Researches on the Natural Production of Nitrates and Nitrites; Application of Mineral Manure to Horticulture.—J. Jeannel.—Reserved for full translation.

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Researches on Liquid Carbonic Acid.—L. Cailletet.—After briefly referring to Thilorier's researches on the liquefied carbonic acid gas (which boils at −78° at atmospheric pressure), the author describes his apparatus for experimenting with this fluid, which is colourless, very mobile, and a non-conductor of electricity; it neither dissolves common salt, sulphate of soda, chloride of calcium, nor carbonate of potassa, which is converted into bicarbonate insoluble in the fluid; carbonate of lime, either in the form of Iceland-spar or chalk, is not dissolved by this fluid, even under a pressure of 130 atmospheres (1950 lbs. to the square inch). Sulphur and phosphorus are insoluble in liquefied carbonic acid, but iodine is somewhat soluble therein; water scarcely dissolves the fluid, but ether and petroleum oil dissolve it readily, and sulphide of carbon dissolves it to some extent. Fatty oils are somewhat soluble in the liquefied carbonic acid, but stearine and paraffin are insoluble therein.

New Native Silver Amalgam from Kongsberg, Norway.—F. Pisani.—Reference is first made to the hitherto-known, and mineralogically described, native amalgams of silver. The two varieties of the mineral investigated by the author are crystalline; one has a dull silver-white colour, the other a light brass-yellow. The first variety was found to contain, in 100 parts, 95·26 of silver, and 4·74 of mercury; the other, 94·94 of silver, and 5·06 of mercury. On further investigation of a sample of native crystalline silver from the same locality, the author found that it also contains mercury, but in larger quantity, viz., 13·7 per cent, and 86·3 per cent of silver; formula, Ag_6Hg.

Action of Sulphurous Acid on Recently-Precipitated Insoluble Sulphurets.—A. Guérout.—This essay treats at length on the action which sulphurous acid exerts upon the recently-precipitated metallic sulphurets. It appears that whereas some of these are quite insoluble in this acid (viz., the sulphurets of copper, silver, gold, platinum, and mercury), others are dissolved, but this is attended by the formation of hyposulphite, and is the result of the three following successive reactions:—(1) Formation of a sulphite and of sulphuretted hydrogen; (2) decomposition of the sulphuretted hydrogen and the sulphurous acid, with formation of sulphur and water; (3) combination of the nascent sulphur with the sulphite.

Tooth of the Elephas Primigenius Found by M. Pinard in Alaska, North America.—A. Gaudry.—The locality where the tooth was found is situated at 59° N. lat. and 156° 41′ W. long. from Paris. The contents of this paper bear mainly upon palæontology; the analysis of the tooth proved it to contain, in 100 parts—Mineral matter, 64·05; organic matter, 23·97; water, 11·98. The author observes that this tooth (although a genuine fossil) contains nearly as much organic matter as that contained in the teeth of living elephants; usually the quantity of organic matter met with in such fossil remains or in bones does not exceed 3 per cent.

This number again contains memoirs on fermentation. Among the papers not relating to chemistry we call attention to an important memoir:—

Theory of the Production of Animal Heat.—Dr. Bouillard.

The American Journal of Science and Arts, November, 1872.

This number contains no original papers relating to chemistry.

La Revue Scientifique de la France et de l'Etranger, November 25, 1872.

This number contains no papers relating to chemistry, but we call attention to an exhaustive memoir:—

The Cattle Plague, Luesbovina.—M. Bouley.—This essay contains important information on the antiquity, origin, and propagation of the disease, and also on the best means of preventing its increase, as well as its complete extinction.

Bibliography.—Under this heading attention is called to the following works just published:—"Etudes sur le Vin, ses Maladies, Causes qui les Provoquent, Procédés Nouveaux pour les Conserver et le Vieillir," par M. L. Pasteur; Paris: Savy, 1872. "Elément de Statistique," par L. Poinsot, Membre de l'Institut et du Bureau des Longitudes; onzième édition, précedée d'une notice sur L. Poinsot, par J. Bertrand, Membre de l'Institut; 1 vol., avec planches; Paris: Gauthiers-Villars, 1873. "Cours de Physique Mathématique," par M. Emile Mathieu, Professeur à la Faculté des Sciences de Besançon; Paris: Gauthiers-Villars, 1872.

Polytechnisches Journal von Dr. E. M. Dingler, second number for October, 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral subjects:—

Preparation of Cyanide of Mercury.—A. Lielegg.—The author describes, and illustrates with a woodcut, an improved method of preparing cyanide of mercury, by passing the vapours of anhydrous hydrocyanic acid into water in which finely-divided oxide of mercury is suspended.

Behaviour of some Metals with a Solution of Ferricyanide of Potassium.—Professor Böttger.—The metals palladium, thallium, magnesium, and arsenicum possess, according to the author's researches, the property of reducing, or converting to a lower degree of oxidation, certain saline solutions; among these are ferricyanide of potassium, converted into ferrocyanide, perchloride of iron into protochloride, persulphate of iron into protosulphate. If, into a solution of 5 decigrms. of ferricyanide of potassium in 100 c.c. of distilled water, a piece of palladium-foil is placed for ten minutes, daylight being excluded, it will be found, on testing this solution with a peroxide salt of iron, that the ferricyanide has been converted into ferrocyanide. Platinum, zinc, cadmium, aluminium, copper, indium, lead, cobalt, silver, mercury, tin, bismuth, antimony, tellurium, gold, manganese, and iron, have no action on the solution.

Analysis of the Commercial Red Phosphorus.—Drs. R. Fresenius and E. Luck.—It appears that this substance contains on an average a total percentage of 92·63 of red or amorphous phosphorus, 0·56 of yellow phosphorus, 1·308 of phosphorous acid, 0·88 of phosphoric acid, and 4·622 of water. The phosphorus is oxidised by nitric acid, and the phosphoric acid estimated as pyrophosphate of magnesia; the yellow phosphorus is eliminated from the mass by means of sulphide of carbon.

Journal de Pharmacie et de Chimie, November, 1872.

In addition to several papers relating to pharmaceutical science, this number contains the following original paper bearing upon chemistry:—

Explosive Property of a Mixture of Nitrate of Potassa and Acetate of Soda.—M. Violette.—It appears that the author, while heating a mixture of nitrate of potassa and acetate of soda in a small glass flask, was seriously injured by a sudden and violent explosion of the substances he operated upon. This accident gave rise to further investigation, the result of which is that a mixture of 100 parts of nitrate of potassa and 60 of acetate of soda, when heated and fused at about 300°, do not explode, and may even, after cooling, be pulverised and granulated; but if the salts are heated to 350°, or ignited by means of red-hot iron, a violent explosion instantly takes place. When either the nitrate or acetate is in excess of the quantity mentioned, the mixture only burns as dry wood would do.

Les Mondes, November 21, 1872.

This number does not contain any original matter relating to chemistry.

Bulletin de la Société Chimique de Paris (double number), October 1 and 15, 1872.

This number contains the following original papers and memoirs:—

Compounds of Yttrium and Erbium.—P. T. Clève and C. Hoeglund.—This second instalment of an exhaustive memoir is elucidated by a large number of complex formulæ; it treats mainly on the salts and double salts of the metals. Most of the salts of yttrium and erbium contain the same quantity of water of crystallisation as the corresponding salts of magnesium and zinc; the sulphates are isomorph with the sulphate of cadmium, and the platinocyanides crystallise in the same form as the platinocyanide of magnesium. The authors have not isolated the metals (erbium and yttrium), but from many of their combinations they appear to be triatomic. No analytical method of separating the metals just named from each other has been found by the authors, but it is easy to deduct from a mixture of known weight of their oxides the atomic weight by the following formula:—

$$ErO = 240{\cdot}19\frac{MO - 75{\cdot}7}{MO}$$

The atomic weight of the oxides obtained from the following minerals has been found by Clève to be—

	Atomic Weight.	Per cent of Oxide of Erbium.
Fergusonite from Ytterby	90·54	39·37
Nohlite from Kongelf	84·80	25·77
Euxenite from Arendal	90·62	38·97
Yttrotantalite from Karafuet ..	80·08	13·14

Solvent Property of Glycerin.—M. Klever.—100 parts of glycerin dissolve the following substances in the following proportions:—Carbonate of soda, 98; borate of soda (borax), 60; arseniate of potassa, 50; arseniate of soda, 50; chloride of zinc, 50; tannic acid, 50; urea, 50; alum, 40; iodide of potassium, 40; iodide of zinc, 40; sulphate of zinc, 35; sulphate of atropine, 33; cyanide of potassium, 32; sulphate of copper, 30; cyanide of mercury, 27; bromide of potassium, 25; sulphate of protoxide of iron, 25; sulphate of strychnia, 22·5; acetate of morphia, 20; acetate of lead, 20; arsenious acid, 20; arsenic acid, 20; carbonate of ammonia, 20; carbonate of soda, 20; chlorate of soda, 20; chloride of ammonium, 20; chlorhydrate of morphia, 20; lactate of protoxide of iron, 16; oxalic acid, 15; acetate of copper, 10; benzoic acid, 10; boracic acid, 10; chloride of barium, 10; bicarbonate of soda, 8; tartrate of iron, 8; bichloride of mercury, 7·5; sulphate of cinchonine, 6·7; tartar emetic, 5·5; polysulphuret of calcium, 5; nitrate of strychnia, 4; chlorate of potassa, 3·5; atropine, 3; brucine, 2·25; iodine, 1·9; veratria, 1; cinchonine, 0·5; quinine, 0·5; morphine, 0·45; tannate of quinine, 0·25; strychnia, 0·25; phosphorus, 0·2; sulphur, 0·1.

Quantitative Estimation of Phenol.—M. Schaedler.—The substance in which the quantity of phenol is to be ascertained is treated with concentrated sulphuric acid, which combines with the phenol (present in any sample of commercial phenol), while the impurities are carbonised by the acid. The resulting phenol-sulphuric acid is converted into a baryta salt, in which the quantity of phenol-sulphate of baryta present is estimated by the conversion of that salt into sulphate of baryta. The operation is described as follows:—2 or 3 grms. of the phenol to be tested are mixed with an equal weight of pure and strong sulphuric acid, and the mixture heated to from 50° to 60° for some

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time; the mixture is next diluted with water, neutralised with carbonate of baryta, decanted, filtered, washed, and the filtrate precipitated with dilute sulphuric acid; the ensuing precipitate of sulphate of baryta is collected upon a filter, washed, dried, ignited, and weighed. 233 parts of sulphate of baryta correspond to 188 parts of phenol; the quantity by weight of sulphate of baryta found has to be multiplied the *rapport* $\frac{188}{233}$, which is equal to 0·8069.

There is added to this number a comprehensive price-list of the well-known firm of Billaut, Billandot, and Co., 24, Rue Sorbonne, Paris, of chemicals and rare chemical compounds, as well as chemical and other apparatus required for scientific research.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, July, 1872.

In addition to two essays relating to chemistry which have been already noticed by us from the *Berichte der Deutschen Chemischen Gesellschaft zu Berlin*, this number contains the continuation of the following memoir:—

On Hypophosphites.—Dr. C. Rammelsberg.—This portion is divided into the following sections:—Reducing action of hypophosphorous and of phosphorous acid; phosphorous acid and silver salts; phosphorous acid and copper salts; hypophosphorous acid and silver salts; hypophosphorous acid and copper salts; hypophosphite of ammonia; composition of fluid hypophosphorous acid.

Composition of the Black Yttrotantalite.—Dr. C. Rammelsberg.—Sp. gr. of this mineral = 5·425; percentical composition of the ignited mineral—Tantalic acid, 49·36; niobic acid, 13·15; tungstic acid, 2·52; stannic acid, 1·19; yttria, 11·03; erbia, 7·16; oxide of cerium, 2·37; lime, 6·47; protoxide of iron, 4·30; protoxide of uranium, 1·72.

Journal für Gasbeleuchtung und Wasserversorgung, No. 19, 1872.

This number contains the following original papers collaterally relating to chemistry:—

Thermostatic Gas-Regulator.—J. Jeannel.—The description, illustrated by woodcut, of an apparatus contrived for the purpose of keeping up a regular and high temperature (above the boiling-point of mercury if desired) for use in scientific research.

Oxygen-Gas Illumination Introduced by Tessié du Motay.—F. Le Blanc.—The first portion of the official report of the author, Chief Inspector of Gas-Works and Gas-Lighting in Paris, to the Conseil Général du Departement de la Seine.

Melanges Physiques et Chimiques Tires du Bulletin de l'Academie Imperiale des Sciences de St. Petersbourg, Vol. viii., 1872.

This number, kindly forwarded to us by Dr. A. Boutlerow, contains the following original essays and papers:—

Trimethyl-Acetic Acid. a New Variety of an Isomer of Valerianic Acid.—Dr. A. Boutlerow.—The introductory part of this lengthy monograph is devoted to the mode of preparation of this acid, only obtainable by a complicated and difficult process of operation. Trimethyl-acetic acid—

$$C\begin{matrix}(CH_3)_3\\CO.HO\end{matrix}$$

is at the ordinary temperature a solid, semi-crystalline, diaphan body, fusing at between 34° and 35°, insoluble in water; the taste of this substance is bitter and pungent, while its smell is similar to that of acetic and valerianic acids, but not so disagreeable as the latter. The baryta salt of this acid has the formula $(C_5H_9O_2)_2Ba+5H_2O$, and is a crystalline body readily soluble in water; it contains 40·41 per cent Ba. The silver salt is anhydrous and crystalline, much resembling benzoic acid when slowly deposited from a hot concentrated aqueous solution; formula of silver salt, $C_5H_9O_2Ag$.

On Trimethyl-Formen-Ethyl, an Isomeric Variety of Hexan.—W. Goriainow.—By causing zinc-ethyl to react upon tertiary iodide of butyl, and purifying the fluid resulting from this reaction, the author has obtained a new hydrocarbon in the shape of a colourless liquid boiling at between 43° to 48°; formula, C_6H_{14}; vapour density—in reference to hydrogen, 43·0; in reference to air, 2·975.

Conversion of Amylen into an Amylic Alcohol by means of Sulphuric Acid.—M. Flavitsky.—After referring to the researches made by Berthelot, Erlenmeyer, and Dr. Boutlerow, relating to this subject, the author describes at length his mode of experimenting, by which amylen, prepared at the chemical works of Dr. Marquart at Bonn by the action of chloride of zinc upon ordinary amylic alcohol, has been converted into an amylic alcohol by the action of sulphuric acid; this alcohol having been converted into a chloride, $C_5H_{11}Cl$, this was found to boil at between 85° and 87°, while, by oxidation, the alcohol yielded aceton.

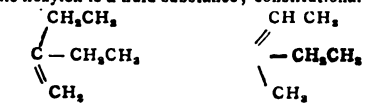
Action of Bromated Bromide of Acetyl upon Zinc-Methyl.—N. Idanow.—In the introduction to this memoir the author mentions a series of researches made on this subject by Terhoukassow. It appears that, by the action of bromated bromide of acetyl upon zinc-methyl, several substances are formed, among which are prominently two alcohols, $C_5H_{12}O$ and $C_6H_{14}O$, but the first-named is the chief product of the reaction. The author continues his researches on this subject, and elucidates the reaction with the following formulæ:—

$$\begin{matrix}CH_2Br\\CO.HO\end{matrix}-O-\quad Br+3CH_2=\begin{matrix}CH_2CH_3\\C(CH_3)_2.HO\end{matrix}$$

$$\begin{matrix}CH_2Br\\CO.HO\end{matrix}-O-HBr+4CH_2=\begin{matrix}CH(CH_3)_2\\C(CH_3)_2.HO\end{matrix}$$

Formation of Tertiary Chloride of Butyl by Means of Isobutylen.—D. Salessky.—The contents of this essay, elucidated by a series of complex formulæ, may be summarised by stating that chlorhydric acid behaves with isobutylen in the same manner as iodhydric acid, the result being the formation of a tertiary chloride of butyl.

New Variety of Hexylen.—N. Tchaïkowsky.—The author records at length the method of preparation of the hexylen alluded to, the formula of which is C_6H_{12}; boiling-point between 68° and 72°; vapour density, in reference to air, 2·908; in reference to hydrogen, 42·0. This hexylen is a fluid substance; constitutional formulæ—



PATENTS.

Communicated by Messrs. VAUGHAN and SON, Patent Agents, 54, Chancery Lane, London, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

3032. J. Hargreaves and T. Robinson, Widnes, Lancashire, "Improvements in treating sulphides, and in obtaining products therefrom."—Petition recorded October 15, 1872.

3067. W. Morgan Brown, Southampton Buildings, London, "An improved composition for preserving wood, metal, stone, brick, paper, textile and felted fabrics, cordage, and cables."—A communication from F. O. Möller, Rue Lavoisier, Paris.—Petition recorded October, 17, 1872.

3300. G. H. C. Hedley, W. Smith, and T. A. Hedley, Salisbury Street, Strand, London, "Improvements in the manufacture and purification of gas, and in the apparatus employed therein and connected therewith."

3308. M. Rae, Uphall, Linlithgow, N.B., "Improvements in the production of artificial fuel and in the machinery employed therein."

3309. H. Deacon, Widnes, Lancashire, "Improvements in the manufacture of bleaching-liquor."—Petitions recorded November 7, 1872.

3318. B. J. B. Mills, Southampton Buildings, Middlesex, "An improved process for cleansing cotton waste and fibrous substances saturated with oils and mixed with *debris* and other matters."—A communication from J. H. Post, New York, U.S.A.

3322. W. Marriott, Huddersfield, "Improvements in the manufacture of salts and oxides of lead, and in apparatus therefor."

3323. A. M. Clark, Chancery Lane, Middlesex, "Improvements in the manufacture of stearic acid."—A communication from E. Deiss, Marseilles, France.—Petitions recorded November 8, 1872.

3335. C. de Sainte Marie, Porte Ste. Marie, France, "An improved process of tanning hides and skins."—Petition recorded November 9, 1872.

3350. H. H. Murdock, Staple Inn, Middlesex, "An improved mode of tanning hides and skins."—A communication from B. Picard, Paris.

3356. J. A. Manning, Inner Temple, London, "Improvements in the treatment of human fœcal matters and in the apparatus or means employed therein."—Petitions recorded November 11, 1872.

3362. L. Banks, Kingston-upon-Hull, "Improvements in the manufacture or composition of fuel."

3371. V. D. de Michele, Delahay Street, Westminster, "Improved process for the manufacture of Portland cement, and in apparatus to be employed therein, and for other purposes."—Petitions recorded November 12, 1872.

3378. F. N. Target, Colyton, Devon, "Improvements in preserving food, and in the means or apparatus employed therein."—Petition recorded November 13, 1872.

3393. G. Clark, Drury Lane, Middlesex, "Improvements in preserving animal and vegetable articles of food, and in vessels, apparatus, and appliances for such preservation."—Petition recorded November 14, 1872.

INVENTION PROTECTED FOR SIX MONTHS BY THE DEPOSIT OF A COMPLETE SPECIFICATION.

3417. F. Hahn, Berlin, "Improvements in the manufacture of steel and malleable iron, and in furnaces therefor."—Recorded November 16, 1872.

NOTICES TO PROCEED.

2093. J. R. Casbay, Newman Street, Oxford Street, Middlesex, "An improved compound to be applied to the surfaces of wood or metal to preserve the same from corrosion or decay."—Petition recorded July 11, 1872.

2115. J. G. Tongue, Southampton Buildings, London, "Improvements in the production of fertilising materials or manures, and in the means and apparatus employed in the manufacture of the same, partly applicable to other purposes."—A communication from H. A. Hogel, New York, and H. B. Bigelow, New Haven, Conn., U.S.A.

2118. E. C. C. Stanford, Glasgow, N.B., "Improvements in preserving and deodorising sea-weed, and in part applicable for deodorising various animal and vegetable substances."—Petitions recorded July 13, 1872.

2205. H. A. Dufrené, Paris, France, "Improvements in concentrating and evaporating sulphuric acid and other liquids, and in the

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apparatus employed therefor."—A communication from M. J. F. R. Faure and J. L. Kessler, Clermont-Ferrand, France.—Petition recorded July 24, 1872.

2510. W. Vincent, Arborfield, Berks, "Improvements in apparatus for manufacturing gas."—Petition recorded August 23, 1872.

2576. G. Spencer, Cannon Street, London, "Improvements in the purification of coal-gas used for illuminating purposes and for mechanical purposes, and in apparatus therefor."—A communication from E. White, New York, U.S.A.—Petition recorded August 30, 1872.

3231. B. F. Weatherdon, Chancery Lane, Middlesex, "Improvements in bleaching textile fabrics and other fibrous materials."—A communication from J. Palliser, R. McDowell, A. Klopsk, and V. Grumel, France,—Petition recorded October 31, 1872.

PATENTS SEALED.

1540. H. Kenyon, H. Kenyon, and J. Swindells, Warrington, Lancashire, "Improvements in the manufacture of chlorine and sulphuric acid."—Dated May 21, 1872.

1583. J. C. Johnson, Newcastle-upon-Tyne, "Improvements in the manufacture of Portland and other cements."—Dated May 23, 1872.

1608. J. H. Selwyn, Gloucester Crescent, Hyde Park, Middlesex, "A new method of treating refractory ores of silver."—Dated May 27, 1872.

1699. J. T. Dann, North Brixton, Surrey, "Improvements in the manufacture of phosphorus."—A communication from G. F. Féron, Rouen, France.—Dated June 5, 1872.

1779. R. McFarlane, Rickmansworth, Herts, "Improvements in treating wood for the production of paper pulp, and in the apparatus employed therefor, parts of which improvements are applicable to the making of steam-tight joints for various purposes."—Dated June 12, 1872.

2277. E. P. H. Vaughan, F.C.S., Chancery Lane, Middlesex, "Improvements in the treatment of phosphates of lime."—A communication from A. Striedter, Paris, France."—Dated July 30, 1872.

2318. J. Henderson, New York, U.S.A., "Improvements in converting cast-iron into steel and wrought-iron, and purifying cast-iron for foundry and other purposes."—Dated August 3, 1872.

2358. T. Warren, Glasgow, N.B., "Improvements in and connected with furnaces employed in the manufacture of glass."—Dated August 8, 1872.

2861. C. W. Siemens, Great George Street, Westminster, "Improvements in the process for the production of iron and steel, and in furnaces or apparatus employed for that purpose."—Dated September 28, 1872.

NOTES AND QUERIES.

Tables of Acids.—Will you kindly let me know the best publication for tables of all the acids diluted, at different strengths, with water?—C. H. H.

Salt.—In reference to salt,—Was the salt mentioned in the Bible NaCl? When Christ said, "Salt is good, but if the salt has lost its savour," &c., what loss or decomposition (if any) is referred to? From the above we should suppose that another salt has been formed. Mr. Maundrell, in the "Valley of Salt, Gebul," says he "broke a piece that had been exposed to the sun and air; though it had the sparkling of salt, yet it had lost its savour; the inner part, which had not been exposed, still retained it." Can you inform me what change takes place, and what brings it about?—S. T. S.

The Reduction of Argentic-Nitrate by Organic Matter.—In January last I placed some crystals of pure argentic nitrate in writing paper, and placed it in a card-box in a cupboard. On opening the paper, which was turned quite black, a few days ago, the $AgNO_3$ was found to have been reduced entirely to the metallic state. It had not fallen to a powder, but was bright and crystalline.—C. T. K.

MEETINGS FOR THE WEEK.

MONDAY, Dec. 2nd.—Medical, 8.
TUESDAY, 3rd.—London Institution, 4.
—— Civil Engineers, 8.
—— Zoological, 8.30.
WEDNESDAY, 4th.—Society of Arts, 8.
—— Geological, 8.
—— Microscopical, 8.
—— Pharmaceutical, 8.
THURSDAY, 5th.—Royal, 8.30.
—— Chemical, 8. M. C. Rammelsberg, "On the Reducing Power of Phosphorous and Hypophosphorous Acids and their Salts," and "On Hypophosphites." Mr. A. H. Church, "New Analyses of some Mineral Arseniates and Phosphates."
—— Royal Society Club, 6.
—— Philosophical Club, 6.
FRIDAY, 6th.—Geologists' Association, 8.

TO CORRESPONDENTS.

D. C.—Your first question is a geological—not a chemical—one your second and third questions may be answered by reference to a work on Chemistry or Chemical Technology.

J. Boss.—You will find works on the subject at the Patent Office Library, Chancery Lane.

BOOKS RECEIVED.

Fownes' Manual of Chemistry. Edited by Henry Watts, B.A., F.R.S. Eleventh Edition. London: J. and A. Churchill.

Introduction to Inorganic Chemistry. By W. G. Valentin, F.C.S. London: J. and A. Churchill.

The Post-Office Directory of Chemists and Druggists, including Chemical Manufacturers, Wholesale Druggists, Drysalters, and Patent Medicine Vendors, of England, Scotland, and Wales. London: Kelly and Co.

The Chemists and Druggists' Diary and Pharmaceutical Text-Book for 1873. London: Office of Chemist and Druggist, 44a, Cannon Street.

A Practical Treatise on Pure Fertilisers. By Campbell Morfit, M.D., F.C.S. London: Trübner and Co.

What to do in Disinfection, and how to do it. Manchester: Mudie's Disinfecting Company.

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The Session 1872-1873 will commence on the 1st of October, when—

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The CLASSES will meet as usual.

The CHEMICAL and TOXICOLOGICAL CLASS on Monday and Thursday evenings at 8 p.m., commencing October 1st.

The LATIN CLASS on Tuesdays and Fridays at 8 p.m., commencing October 2nd.

The MATERIA MEDICA and BOTANICAL CLASS, every Wednesday and Saturday at 8 p.m., commencing October 3rd.

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THE CHEMICAL NEWS.

VOL. XXVI. No. 680.

ON THE SULPHUROUS IMPURITY IN COAL-GAS.*

By A. VERNON HARCOURT, F.R.S., Sec. Chem. Soc.

THE luminous flames we use to light our houses after sunset are all equally gas flames.

The gas which burns round the wick of a candle is formed by the action of heat on the grease of which the candle is made. The gas which burns over the wick of an oil lamp is formed by the action of heat on the oil. The gas which burns over a "gas-burner" is formed by the action of heat on coal.

By the heating of any of these substances many different kinds of gas are produced, some of which become liquids if they are allowed to cool, while others are permanently gaseous. In the case of candles and lamps, when the hot gas is burnt as fast as it is made, the uncondensable and the condensable are burnt alike, the latter contributing even more than the former to the luminosity of the flame. In the case of coal-gas, which is kept for many hours, and has often to travel along many miles of iron piping before it is burnt, only very little condensable gas reaches the burner. In this respect "gas" illumination is at a great disadvantage as compared with candles or lamps. To counterbalance this disadvantage gas must be produced from some substance which is much cheaper than grease or oil, and such a substance we have in coal. But coal, like all minerals obtained on the large scale, is mixed with small quantities of other substances, and, in particular, masses of coal always contain a greater or less proportion of a mineral known, according to its form, as pyrites or marcasite, composed of 8 parts of sulphur united with 7 of iron. When coal is heated, a part of the sulphur from this mineral unites with the carbon and hydrogen of the coal, and thus the illuminating gas formed from coal is contaminated with at least two sulphur compounds—carbon bisulphide and hydrogen sulphide. Such gas yields when it is burnt, in addition to water and carbon dioxide, sulphur dioxide produced by the burning of the sulphur. This gas has a well-known pungent smell; it acts on various colouring matters, and it is gradually changed in presence of air and moisture into a far more destructive substance, called hydrogen sulphate or oil of vitriol. Unlike sulphur dioxide, which is a gas and can be removed by ventilation, hydrogen sulphate is not volatile, and exercises a continued corrosive action upon organic materials or fabrics on which it is deposited. In a furnished room the leather bindings of books and coverings of furniture are especially liable to be injured thus; perhaps because this material, being a better conductor of heat than others which are used for the same purposes, is more bedewed after gas has been lighted in a room than they are, and also because it requires less often to be cleaned or renewed. Fortunately the conversion of sulphur dioxide into hydrogen sulphate takes place so slowly that in a room lighted with gas and well ventilated a very small part of the sulphur which gas is liable to contain remains in this destructive form. Fortunately, also, the quantity of sulphur which gas as at present manufactured is liable to contain is very small. In a room lighted with four gas-burners the volume of sulphur dioxide mixed with the atmosphere of the room in the course of an hour is about one-hundredth of a cubic foot. The amount actually present at any moment, if the room is fairly ventilated, is a small fraction of this volume. Nevertheless, it is possible, and even probable, that some injury, especially to the bindings of books, may in the course of years be caused under these circumstances; and it is desirable, with a view to avoiding any such injury, and also with a view to allaying the apprehension of it, that the proportion of sulphur compounds in coal-gas should be reduced as far as possible.

A ton of coal may contain about 30 lbs. of sulphur: it yields nearly 10,000 cubic feet of gas, and a considerable part of the sulphur contained in it is given off with the gas in combination with either carbon or hydrogen. Of these two elements, hydrogen claims by far the larger proportion, not less than 10 parts for 1 that is united with carbon. For the purification of gas from hydrogen sulphide, excellent methods are everywhere in use. The gas is passed through layers of slaked lime or of iron oxide, by either of which substances all the hydrogen sulphide is capable of being completely absorbed. But the smaller quantity of sulphur existing in the form of carbon bisulphide is not arrested by these agents, nor is there at present any material or process known by which it can be effectually removed.

When coal-gas which is pure from hydrogen sulphide is heated and tested again, it is found to contain this impurity, showing that some ingredients of the gas are capable of producing hydrogen sulphide by their mutual action. Hydrogen seems to have a much stronger affinity for sulphur than carbon has. One consequence of this difference is the unequal partition of the sulphur between the two elements in the gas retort. But this inequality does not reach its limit in the short time which elapses between the formation and cooling down of the gas; and accordingly, when foul gas (or gas which has not been purified from hydrogen sulphide) is further heated, the proportion of hydrogen sulphide in it is increased, and that of carbon bisulphide diminished. From a number of experiments in which foul gas was passed through an iron tube 3 inches in diameter, filled with iron turnings and heated for a length of about 2 feet to low redness, it appeared that the amount of carbon bisulphide could be so far reduced that the gas, after purification from hydrogen sulphide, contained 5 or 6 instead of 30 grains of sulphur in 100 cubic feet. The gas was driven through the heated tube at a rate of from 1 to 2 cubic feet a minute.

A somewhat greater reduction in the amount of sulphur is obtained by heating the gas after, instead of before, purification and purifying it a second time. If it is the case, as seems probable, that the sulphur present in coal-gas distributes itself when the gas is heated between the carbon and hydrogen in a ratio dependent upon the relative affinity for sulphur of the two elements, the proportion of carbon bisulphide to the total sulphur in the gas will be always the same when the composition of the gas is the same, and when it has been heated long enough for the establishment of an equilibrium. Accordingly we should expect the removal of sulphur, by the conversion of carbon bisulphide into hydrogen sulphide and the absorption of the latter, to be accomplished more effectually with gas from which the chief part of the sulphur had already been extracted. And this, as has already been stated, is found to be the case.

The nature of the chemical change which takes place when coal-gas is heated may be illustrated by passing hydrogen over the mouth of a tube containing carbon bisulphide, and thence through a piece of combustion tubing heated nearly to a red heat. The mixture of hydrogen and carbon bisulphide vapour has no action on a solution of lead acetate; but, after the application of heat, the gas which issues produces at once a black precipitate, proving that hydrogen sulphide has been formed. This change occurs readily with hydrogen which has been carefully dried; but the presence of moisture appears to promote it; and as coal-gas contains a quantity of aqueous vapour, much more than sufficient to react with the maximum amount of carbon bisulphide, it is possible that the formation of hydrogen sulphide when coal-gas is heated may be partly due to the intervention of moisture.

If clean iron nails are heated to redness in a glass tube,

* Read before the Royal Institution of Great Britain.

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and coal-gas is passed slowly over them, a soft black carbonaceous deposit is formed, and the gas is deprived of a part of its carbon. If, however, the gas be passed through more rapidly, no such deposition takes place, although the time of contact of the gas with the heated surface is still sufficient to effect the conversion of the carbon bisulphide into hydrogen sulphide. In the latter case it may be presumed that no change occurs in the illuminating power of the gas. But to establish a point which is of capital importance, some direct observations were made on the illuminating power of gas thus treated. It was found with gas passing at the rate of 5 cubic feet an hour through a half-inch iron tube, heated for a length of 12 inches, that, when the heat did not exceed low redness, no change was observable. When the heat was raised to bright redness, there was a perceptible increase in the illuminating power.

If the process of heating coal-gas, in order to remove the sulphur contained in it, should be employed on the manufacturing scale, the rate of transmission of the gas through the heating apparatus would necessarily be such as to render any deposition of carbon very unlikely. But even where such deposition takes place, it is not necessarily accompanied by a diminution of the illuminating power.

An interesting experiment, from this point of view, is the decomposition of marsh-gas by the electric spark. When a stream of sparks from a Ruhmkorff coil is transmitted between the ends of platinum wires through a small quantity of marsh-gas enclosed in a glass tube over mercury, the gas gradually expands. In about ten minutes it is nearly doubled, and at the same time a black deposit appears on the tube, in the neighbourhood of the wires. Here the intense heat applied has effected an almost complete decomposition of the hydrocarbon into its elements. But at the same time there is found a small quantity of some more condensed hydrocarbon, probably acetylene. On expelling the gas through a jet attached to the upper end of the tube, and burning it, the flame is seen to be much more luminous than that of marsh-gas itself. The fact of which this experiment gives a striking illustration is that the illuminating power of gas depends much more upon the nature of the hydrocarbons it contains than upon the total amount of carbon. How great would be the gain to the manufacturers of coal-gas, if such an operation as this were possible on the large scale, by which the volume of gas is doubled, and its illuminating power, at the same time, greatly increased!

As far as chemistry is concerned, the simple operation of heating gas appears to offer the means of a sufficiently perfect purification. The construction of a suitable system of iron pipes for heating the gas, and the best mode of obtaining and applying heat, is a problem for the engineer. On the scale on which gas is manufactured, all the apparatus for dealing with it must be of a magnitude to which it is difficult to pass, even in imagination, from the small scale of laboratory experiments; but, otherwise, the problem does not appear to be one of any peculiar difficulty. It may perhaps be found possible to employ some of the waste heat of the retort-house for this purpose, and thus to effect the required purification without much increasing the consumption of fuel.

PASSAGE OF HEAT-RAYS THROUGH INCLINED DIATHERMANOUS PLATES.

In a recent number of Poggendorff's *Annalen* Prof. Knoblauch describes some careful researches on this subject, of which we propose here to give the chief results.

The first part of his paper treats of the influence of polarisation on the phenomenon; the second, that of the nature of the plate as regards absorption.

The sun's rays were directed horizontally, by means of a heliostat, into a dark room, where they met the plate (which was movable about a vertical axis), and, passing through it, affected a thermo-pile and galvanometer. In entering the chamber the rays passed through a Nicol's prism. The plates first employed were of colourless plate-glass, one of them 1 m.m. thick, the other 2·5 m.m. (The material of the former, in considerable thickness, looked slightly blue,—that of the latter slightly yellow).

The rays were first allowed to meet the surface at a right angle, and a certain deflection of the needle (15°, 10°, or 9°) was obtained by adjustment of a slit. The plate was next turned on its axis to a different angle.

In previous experiments with polarised heat-rays the maximum quantity of heat was found to be transmitted through diathermanous plates, when the planes of polarisation and refraction coincided, or crossed at right angles.

From the first table in the paper before us it appears (*first case*) that with the plane of polarisation horizontal, and coinciding with the refraction-plane, the quantity of heat transmitted *diminished* as the angle of incidence, or the number of plates, was increased.

On the other hand (*second case*), with the planes of polarisation and refraction crossing at right angles, the heat transmitted *increased* in quantity with increased angle of incidence and number of plates, till the angle 55° was reached (the so-called angle of polarisation); then there was gradual decrease.

For example, in the first case, when one plate was turned from 0° to 55°, the needle moved from 15° to 12°; when eight plates were so turned, it moved from 15° to 7·5°. In the second case, on a like motion of one plate, the deflection was increased from 15° to 17°; of eight plates, from 15° to 23·46°.

The decrease which took place in both cases after 55° was much greater in the first case than in the second.

Further, even at 60° inclination of plate in the second case, the heat produced a deflection of 16·62° for one plate, and 22·72° for eight plates, as compared with 15° when the angle of incidence was 0°.

These results were compared with others which were obtained after placing the principal section of the Nicol at 45°, instead of vertically or horizontally, the rays in this case being taken as corresponding to unpolarised rays. With this arrangement, the absorption of the glass was little affected by increasing the inclination or the number of plates, no change appearing till 35° inclination with a plate of one kind of glass, nor till 55° with one of the other; thereafter a slight decrease. With eight plates of either kind the deflection increased somewhat till 45° or 55°, after which there was decrease. Thus we have, in the present arrangement, a beginning of that which reached its maximum when the polarisation and refraction-planes crossed. The reason why this case, while between the first two, shows the approximation now referred to, is, according to Prof. Knoblauch, that the mere passage through the inclined plates calls forth a polarisation (increasingly imperfect) the plane of which is at right angles to the plane of refraction.

Another point may here be noticed. The coefficients of absorption, corresponding to changes of angle in the plate above 55° where the Nicol's principal section was vertical (and hence the two above-mentioned planes coincided), stood further apart in the case of one plate (*e.g.*, 25 : 33) than where there were several plates (53 : 67). With the principal section horizontal, on the other hand, they were nearer to each other with one plate (4 : 9) than with several (11 : 56).

To determine how, with the principal section of the Nicol horizontal (and the two planes crossing), the increased transmission of heat took place in a substance showing very little absorption of heat-rays, Prof. Knoblauch made some experiments with sylvin and rock-salt. The sylvin had a thickness of 4 m.m. (the least possible), and this was found to give too much absorption, the quantities of heat transmitted being less than with thin glass plates.

The increase of transmission, which with the glass

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plates continued to 55° incidence, reached a maximum in the sylvin about 35°, which continued till 55°.

Plates of rock-salt were procured having a thickness of 1 m.m. Taking these as showing the least possible absorption of the heat-rays, Prof. Knoblauch gives a table of the results obtained, and bases on it a statement of the law in its simplest form. It is this :—

(1). With the principal section of the Nicol vertical (*i. e.*, the planes of polarisation and refraction coincident), the coefficients of absorption between 55° and 65° are smaller than between 45° and 55°, a peculiarity which, in substances somewhat absorbent of heat (as most glasses), is masked to an extent dependent on the thickness.

(2). With the principal section horizontal (*i. e.*, with planes of polarisation and refraction crossing), the transmission steadily increases till the angle of incidence becomes equal to the angle of polarisation. And when the plate is inclined beyond the angle of polarisation, decrease takes the place of increase.

(3). With the Nicol at 45°, or with unpolarised rays, the differences first commence, in the case of the rock-salt plates, at an inclination over 55°. Should this appear surprising, when compared with results from the glass and thicker rock-salt, it is to be remembered that the surface of the split lamellæ was much less perfect and favourable to diffusion of the rays than that of the plate-glass or the polished thick plates of rock-salt.

The second influence examined by Prof. Knoblauch (nature of the plate's substance) we defer for the present.

A. B. M.

ON SULPHOPHENIC ACID.*

By A. B. PRESCOTT, M.D.

The limited observations and results which are submitted to the Association in this note, relate to a few points in the preparation, character, and composition of sulphophenic acid and its salts; and, in connection with the report, the interest of the subject has tempted the writer to notice some features of its literature.

The formation of sulphophenic acid is sufficiently simple, being the inevitable result of bringing pure sulphuric and phenic acids in contact; but we have yet to study the most advantageous proportions and conditions for the combination. If the mixture of acids be diluted beyond a certain point, no combination takes place; and when the concentrated acids act upon each other, some portion of each acid remains uncombined under all conditions. Dr. Hager has stated, that however long digestion be continued at 125° F., at least 10 per cent of the sulphuric acid refuses to combine; and he recommends the addition of 120 parts of concentrated sulphuric acid to 100 parts of phenol.

By employment of higher temperatures, I find that the residue of sulphuric acid may be reduced to about 5 per cent of that taken. 50 grms. of sulphuric acid (chemically pure, sp. gr. 1·843), were added to 50 grms. of carbolic acid (Calvert's medicinal, No. 2). The mixture was held at 300° F. for half an hour, cooled gradually with the sand-bath, and then set aside in an open vessel, at about 55° F. The mixture cooled to a thick syrupy liquid, wherein the woolly tufts shortly appeared, and at the expiration of four days, its lower four-fifths consisted of a firmly coherent crystalline mass, while the supernatant liquid was more limpid than concentrated sulphuric acid. Separate determinations of the uncombined sulphuric acid in the supernatant liquid, and of that in the crystalline mass, gave the following results :—

	Barium Sulphate.		Grms. $HO.SO_3$.
Liquid yielded	1·1710	=	0·4924
Crystals ,, ...	5·1325	=	2·1584
	Total..		2·6508

As the 50 grms. of concentrated sulphuric acid contained 48·5 grms. of monohydrated acid, it appears that $5\frac{1}{2}$ per cent of the same escaped combination. Accepting the sulphophenic acid as its typical composition,—

$$HO.C_{12}H_5O.2SO_3$$

(the correctness of which I confirmed in the same sample), it follows that 43·979 grms. of absolute phenic acid entered into union; leaving 6·011 grms., or 12 per cent of the 50 grms. weighed, to be set down as water, impurity, and unappropriated phenol.

Although phenol is not miscible in sulphuric acid before combination, or much more soluble in dilute sulphuric acid than in water, it is miscible in all proportions with concentrated sulphophenic acid, and in less than half its bulk of sulphophenic acid diluted with 4 volumes of water. The addition of much more water precipitates the phenol, which is again dissolved by the addition of a little more sulphophenic acid. Hence, uncombined phenol, however abundant, cannot be separated from sulphophenic acid by water.

The phenol which remains free is less readily removed from the product than the uncombined sulphuric acid; and if the diminution of the former could be secured by a proportionate increase of the latter, without doubt the quantity of sulphuric acid should be increased to this end. But any considerable excess of sulphuric acid prevents the crystallisation of the crude sulphophenic acid; and whether it be due to non-occurrence of crystallisation or not, so far as I have been able to ascertain by the odour and the intensity of qualitative tests, even large stœchiometric excesses of sulphuric acid still leave nearly the same quantity of phenol not appropriated.

The uncombined sulphuric acid is very perfectly and readily removed from the diluted mixture by carbonate of barium, added carefully until the filtrate is precipitated by neither solution of barium nor by sulphuric acid; and this agent will continue to be preferred for this purpose. Oxide or carbonate of lead leaves traces of lead sulphate, and carbonate of lime more than traces of lime sulphate in aqueous solution; but as the sulphophenates are better purified by crystallisation from alcoholic than from aqueous solution, and as the sulphate of lime can be filtered clean from alcohol, the very cheap carbonate of lime may be found applicable in the pharmaceutical manufacture of the salts of sulphophenic acid.

The residual phenol may be removed (1) directly from liquid crude sulphophenic acid by repeated washings with stronger ether. The washing should be continued until the ether, syphoned off, leaves a residue free from the odour of phenol, and, when warmed with nitric acid and then saturated with potassa, is not more than faintly coloured. The water taken up by the ether will carry traces of sulphophenic acid, responding slightly to the latter test. The uncombined phenol is also left behind, (2) by crystallisation of the sulphophenates, preferably from alcoholic solution. When free sulphophenic acid is to be prepared as a final product, its barium salt is decomposed by an equivalent quantity of sulphuric acid, or the calcium salt by oxalic acid or in alcoholic solution by sulphuric acid, or the lead salt by sulphydric acid.

The combination of sulphuric acid with phenol, at any temperature, develops the wine tint which is seen, to a greater or less extent, in sulphophenates; the colour being somewhat deeper if a high temperature has been employed. The application of 300° F. for one half-hour occasions a bright wine colour to be transmitted through a layer 3 inches deep; and the temperature may be kept for some minutes at the boiling-point of phenol (369° F.), with a scarcely perceptible deepening of the tint. This colour is (mainly if not wholly) due to a substance removable from liquid sulphophenic acid by ether washing. In the first washing, the supernatant ether shows a tint of the same depth as the washed acid below; but in subsequent washings the ether colours itself rather less deeply than the tint of the aqueous layer, and I am scarcely able to say that it is practicable to remove every trace of

* Read before the American Pharmaceutical Association.

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colour by this means. The evaporation of the decanted ether leaves behind the colour substance a thick, oily liquid of intense blood-red colour, very little odour, fiery taste, strong capillary attraction, colouring paper without the production of a transparent spot, soluble in alcohol, but insoluble in water, very slight acid reaction (probably due to contamination). Heated with soda-lime, it does not generate ammonia; its colour is not changed by chloride of lime, or by heating with corrosive chloride of mercury. The colour removed by ether from carbolic acid which has grown brown in the light is an altogether different substance. I have not succeeded in removing more than traces of colour from crystallised sulphophenates by ether.

Sulphophenates are prepared (1) from crude sulphophenic acid by its direct union with bases or their carbonates; (2) in the same manner from the acid purified only by removal of sulphuric acid, or purified by removal of both sulphuric acid and phenol (ether washing); (3) from crystallised sulphophenates of barium or calcium, or lead, by double decomposition with sulphates or carbonates (calcium) of the bases desired; (4) sulphophenate of zinc by decomposition of the lead-salt with metallic zinc; (5) from sulphophenic acid, first set free from its crystallised salt, and then combined with the bases or their carbonates. By careful and repeated crystallisations, a pure product may be obtained even by the first method, but it is certainly preferable to remove the free sulphuric acid as in the second. For administration, the close removal of the phenol is imperative, as sulphocarbolates are given in doses relatively large.

Sulphophenic acid is soluble in alcohol, insoluble in ether and chloroform. Its salts are sparingly soluble in cold, freely soluble in hot alcohol, insoluble in ether. Pure sulphophenic acid, in aqueous solution of 2 to 5 per cent, promptly coagulates albumen, as likewise do the sulphophenates with acetic acid; but the neutral sulphophenates of alkalies and alkaline earths do not coagulate albumen. To ascertain antiseptic powers, a comparative trial was made by immersing and setting aside pieces of fresh lean meat in the following liquids:—

(*a*). Distilled water.
(*b*). One per cent solution of sulphophenate of sodium.
(*c*). Five per cent ,, ,, ,,
(*d*). Five per cent solution of purified sulphophenic acid.
(*e*). One per cent solution of sulphuric acid.
(*f*). One per cent solution of phenol.

At the expiration of 24 hours, a slight odour of incipient animal decomposition was observable from (*a*), (*b*), and (*c*).

At the end of 36 hours, (*b*), (*c*), and (*a*) evolved offensive odours, that of (*b*) being decidedly most offensive, while (*a*) was somewhat less offensive than (*c*). At this time some sulphate occurred in (*c*), as evinced by barium precipitate, none being found in (*a*). Solution (*b*) was now thrown out.

After 46 hours the putrefaction in (*c*) had advanced little farther than at the previous observation, and was less offensive than that of (*a*), while the filtrate of (*c*) gave a heavier precipitate of barium sulphate than before. A very slight barium precipitate was now obtained from (*d*).

After 60 hours the putrefaction in (*c*) had extended but slightly beyond that previously noted, while the solution gave a still somewhat increased barium precipitate. The barium precipitate from (*d*) was still very slight. Not the slightest fœtor was discoverable in (*d*), (*e*), or (I need hardly state) in (*f*). A 5 per cent solution of sulphophenic acid which had stood open during this time, in the same room, gave no precipitate with chloride of barium. No odour of phenol was detected in (*c*).

It would seem from these observations that sulphophenic acid has a coagulating power and antiseptic effect sufficient, in tolerably concentrated solutions, to preserve animal substance, and that the contact of the coagulated substance effects a very slight separation of sulphuric acid. Also, that sulphophenates do not at all delay the *inception of animal* decomposition, but do, in some degree, retard the progress of such decomposition, in consequence of which the sulphophenate suffers decomposition (into sulphate, sulphuric acid, and phenol), while no perceptible odour of phenol is evolved.

Neither sulphophenic acid nor its salts suffer decomposition in aqueous solution in the air, and neither suffer more than slight decompositions by long boiling in dilute solutions.

The most delicate test for sulphophenic acid is that likewise the most delicate for phenol,—the production of picric acid and its salts. Strong nitric acid is added and heat applied to form tri-nitrophenic acid instead of the mono- or di-nitrophenic acid, liable to remain if heat be not used. According to Carey Lea, water containing $\frac{1}{100000}$ of tri-nitrophenic acid is distinctly yellow, and when only $\frac{1}{200000}$, the tint is perceptible in a stratum 1 inch deep. The delicacy of the test is much increased by adding sufficient potassa to neutralise both the picric and undecomposed nitric acids. I find that 1 part of sulphophenate in 50,000 parts of water, boiled with nitric acid and saturated with potassa, appears distinctly yellow in a stratum 1 inch deep, and that 1 part of phenol in 100,000 parts of water, treated in the same manner, produces an equal depth of tint. The tri-nitrophenate of potassa, requiring 260 parts of cold water for solution, is easily crystallised in its beautiful slender yellow needles.

The *composition* of sulphophenic acid authorises its classification with the sulphovinic acids, and the brotherhood of their derivatives indicates close relationship between phenol and the alcohols. The exceeding interest of these chemical analogies is enhanced by the fact that both sulphophenates and sulphethylates are at the present time on trial as therapeutic agents, and that both are believed to suffer similar and gradual decompositions in the animal body—the former furnishing phenol as a medicinal agent, and the latter yielding sulphate as the active agent. Phenol has the composition of a monatomic alcohol; it is neutral to test-papers, and its combinations with bases are scarcely stable enough to be classed as salts.

Sulphethylic acid is much less stable than sulphophenic acid; the former in dilute solutions decomposes gradually in the air and more rapidly on boiling, while the latter may be concentrated on the water-bath or even boiled without injury. The former decomposes at its own boiling-point, evolving oxide of ethyl; the latter decomposes at the boiling-point of phenyl hydrate, which distils, for some time, intact. An attempt to produce phenic ether by distillation from sulphophenic acid serves to show that, if possible, it must succeed by the introduction of peculiar conditions. When the boiling-point rises above that of phenol, that substance has mostly passed over, and sulphurous acid and quite indeterminate oxidised products appear. The double oxides of phenyl and methyl, phenyl and ethyl, phenyl and amyl, &c., are well known, but may perhaps as well be considered phenates as conjugated ethers, certainly simple phenic ether has not been obtained from them. Scrugam inferred the production of oxide of phenol in the reaction between chloride of phenyl and phenate of sodium, heated, but distillation failed to furnish the supposed product. Finally, Hoffmeister (*Deut. Chem. Ges. Ber.*, iii., 747, and *Journ. Chem. Soc.*, April, 1871) has declared the production of oxide of phenyl by distilling phenol with sulphate of azophenylamine.*

The purified phenic ether is a colourless solid, melting at 82° F., and boiling at 478° F. (or 190° above the boiling-point of phenol). The difficulty of phenic etherification seems to be explained in the fact that the ether has a higher boiling point than its alcohol. The new product is described as very stable, having an agreeable aromatic odour, and its therapeutical properties will be looked for with interest.

Should it be found that sulphophenates are producible with other than the typical formula, $MO.C_{12}H_5O.2SO_3$ (or

* $HC_6H_4N_2SO_4+HC_6H_6O=(C_6H_5)_2O+H_2SO_4+N_2$.

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$MC_6H_5SO_4$), the fact will scarcely present a dissimilitude with the sulphethylates. For we have ethionic acid, $C_4H_6O_2.4SO_3$ (in the salts of which two molecules of base are substituted for two of water), and isomers of sulphethylic acid are described.

An analysis of selected crystals of sulphophenate of barium, dried in fine powder at 212° F., until it ceased to lose weight, gave the following results for 1000 grms.:—

	Found.	Calculated from $BaO.C_{12}H_4O.2SO_3$.
BaO	0·3165	0·3167
SO_3	0·3224	0·3312

The baryta was precipitated with dilute sulphuric acid. For the determination of the sulphuric anhydride, the salt was decomposed with strong nitric acid on the water-bath, in the presence of an excess of nitrate of barium; most of the nitric acid evaporated, and the remainder nearly neutralised with potassa, and the precipitate washed first by decantation and then on a filter in the usual manner. It is difficult to decompose by nitric acid without loss of sulphuric acid, unless in the presence of excess of barium salt.

It is stated (*Rabantan, Schmidt's Jahrbucher*, 148, 610) that sulphethylate of sodium, when administered, very gradually splits into sulphate of sodium and alcohol in the alimentary canal, and the dose of the sulphethylate may be 380 grains—not higher than the dose of sulphate.

Dr. Sansom (*Practitioner*, 1869, July) states that after the administration of sulphophenates, an increased quantity of sulphates appears in the urine, while the breath bears the odour of phenol. He gives doses as large as 1 dram, which, if fully decomposed in the body, would yield over 20 grains of phenol, or many times the dose of this agent. Thus the therapeutical potency of these agents shows that sulphophenates are less easily decomposed than sulphethylates, in the animal body as well as in the laboratory.

MINERALOGY.

THE second lecture of the course, by W. W. Smyth, F.R.S., was on "Calcareous or Lime-Containing Minerals."

In the minerals included under this term, lime (Latin, *calx*) forms the principal constituent. The first of the series is that known as "calcite," which the lecturer characterised as one of the most protean substances in Nature. Its percentage chemical composition is—CaO, 44; CO_2, 56. In its purest state it is frequently found as crystals, associated with the ore of lead, or lining the joints and fissures which are so common in limestone rocks: in the latter case it is sometimes in crystals, sometimes in the form of layers on the sides of the fissure. A variety of calcite known as "dog-tooth spar" is of frequent occurrence in the central parts of England. Calcite crystallises in the hexagonal system, and possesses some wonderful and interesting physical properties. One of the most remarkable is that of double refraction, which is seen to great advantage in crystals of Iceland spar, although not peculiar to that substance. It consists in the splitting up of an incident ray of light into two portions, which in their passage through the crystal are more or less separated from each other, the distance of separation increasing with the thickness of the crystal. Two fine specimens were exhibited; one in its native state, with a smoky film on its surface; the other, which had had this film cleaved off, was beautifully transparent, and on looking at a wafer placed beneath two distinct figures of it might be seen. Another property which calcite possesses, in common with some other minerals, is that of cleavage, by which all the pieces of a broken crystal will take the same form as the perfect crystal, or at least have the same angular measurements.

Another group in the series is that of the marbles, which was known to the ancients, and applied by them to ornamental purposes. They gave the name "marble" (from a Greek word, meaning "to shine") to any substance which would take a polish and was capable of being applied to decorative purposes. We restrict the term to carbonates of lime, of a certain degree of hardness, and susceptible of a certain amount of polish. One of the purest varieties of marble, and one which was highly valued in olden times for sculptural purposes, is that known as "Parian marble," which is obtained from the Island of Paros, in the Grecian Archipelago. Another variety, which is far more common amongst us now, is the Carrara marble, which, under the name of Marmor Lunensis, was in great repute in the time of the Roman Empire. The modern town of Carrara stands on the shores of the Gulf of Genoa, and the entire population of the place is supported by the produce of its marble quarries. There are other varieties of Carrara marble besides the pure white statuary rock, marked in various ways; and in fact there are frequently, in all limestone districts, numerous varieties which are quite peculiar to that district. Thus we have black marble from Kilkenny, in Ireland, and extremely varied kinds from Derbyshire and Yorkshire. But as a rule the limestones of this country, in point of beautiful colours, are inferior to those of the South of Europe, the only notable exception being a variety, Devonian marble, from near Torquay.

The Lecturer also remarked, as a curious fact, that as you proceed southward in Europe you find a more and more extensive use of these beautiful stones, and of other natural productions, in domestic architecture, and expressed a desire to see this practice more common in this country. But the wealth of this country in these kinds of rocks consists in the vast beds of "limestone," generally so-called, which are carbonates of lime more or less incapable of taking a fine polish. These stores of limestone have not yet been developed to their full extent, and, speaking generally, the mineral resources of our island have not been properly investigated; in many cases we have had to depend for supplies on foreign sources. The chief object of this Museum of Practical Geology is to illustrate and teach what is known and what is being discovered on this subject.

This same substance is also found in the form of stalactites and stalagmites, so frequently to be seen in the caverns of limestone districts. The name "stalactites" is given to those masses which hang pendant from the roof, "stalagmites" to those which rise from the floor. Their principle of formation is due to the fact that water, holding carbonic acid in solution, is capable of dissolving and carrying away portions of limestone, leaving, in most cases, hollows or caverns in the rocks; and this explains the prevalence of caverns in limestone districts. The carbonic acid is derived by rain water, partly from the air and partly from decomposing vegetable and animal matters. When the water evaporates the lime is left behind,—as, for instance, in the case of the drops in the roof of the cavern,—and a stalactite is formed, and grows by the addition of matter from the water trickling down outside it, though sometimes there is a narrow pipe down the centre of the mass. A section across one of these is often curiously variegated, both in the colour and form of the various layers, and in this way (more especially by sections of the stalagmites) the ancients obtained what they termed "alabaster," or what is now known as "Algerian onyx."

The hydrated sulphate of lime, or gypsum, is quite distinct from the above carbonates; it crystallises in the oblique system. Fine crystals of it are found in the counties of Nottingham and Derbyshire, where it is manufactured into plaster of Paris by merely driving off its water. Its composition per cent is—CaO, 32·6; SO_4, 46·5; H_2O, 20·9.

A phosphate of lime is also known, under the name "apatite," in which 89 to 92 per cent of calcic phosphate is combined with fluoride or chloride of calcium. Great

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quantities of this phosphate of lime have been imported for use as artificial manure.

Fluor-spar is another calcareous mineral found crystallised in cubes, of various colours, the purples and blues predominating. It is known in Derbyshire as "blue John," and is capable of being worked into most beautiful objects. Its percentage composition is—Ca, 51·9; F, 48·1.

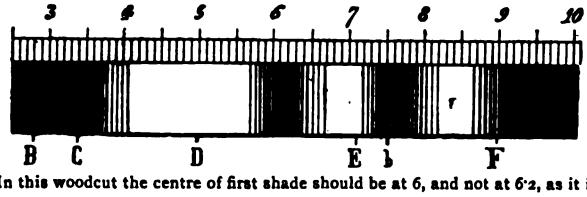
FLUORESCENT RELATIONS OF CERTAIN SOLID HYDROCARBONS FOUND IN PETROLEUM DISTILLATES.

By HENRY MORTON, Ph.D., President of the Stevens Institute of Technology.

WHEN the residues left in the distillation of petroleum for the manufacture of illuminating oils are re-distilled to obtain lubricating oils and paraffin, there passes over near the close of the operation, and when the still is at the bottom almost or even quite red-hot, a thick tarry matter of a sepia colour, which is used like the corresponding product of coal-tar distillation as a lubricant for very heavy and rough machinery, such as the necks of the rollers in iron rolling-mills.

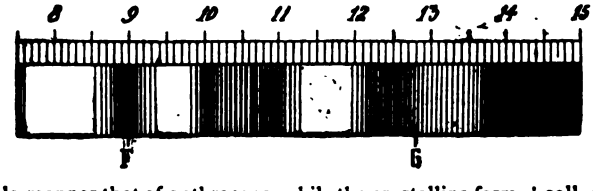
A specimen of this was given to me in the early part of last February by Prof. E. H. Horsford, and on examination and treatment with benzine, alcohol, and ether, I extracted from it a solid crystalline body of a yellow-green colour, and remarkable fluorescence. This I described under the name "viridin" in a paper read before the American Institute in New York, on the 29th of March, and drew attention to the very remarkable spectrum which its fluorescent light yielded, which resembled in a remarkable manner that of anthracene, while the crystalline form, solubilities, and fusing-points of the two bodies were decidedly unlike.

FIG. 1.



In this woodcut the centre of first shade should be at 6, and not at 6·2, as it is.

FIG. 3.



The amount of material given me by Prof. Horsford was, however, insufficient for further study, and I encountered some difficulty in obtaining a fresh supply. At last through the kindness of my friend, Dr. G. F. Barker, with whom I am now engaged in a thorough investigation of the properties of this material, I was introduced to Mr. John Truax, who has kindly supplied me with an abundance of the required material with which the observations about to be described were made.

To make clear what follows, I must say a few words about the preparation of the substance, although for all details I would refer to the paper by Dr. Barker and myself, to appear subsequently.

The crude tarry matter is well washed with benzine (petroleum naphtha), then with alcohol, and is lastly dissolved in benzole (coal-tar naphtha), filtered hot, and crystallised out on cooling. It is then obtained as a mass of very minute needle-like crystals, of a greenish-yellow colour and pearly lustre in the mass. If a portion of this is illuminated with light which has passed through a tank of ammonio-sulphate of copper, it is seen to emit a brilliant green light, and if this is examined with a spectroscope the spectrum shown in Fig. 1* is seen.

The method actually employed for these observations is represented in Fig. 2 where A represents a port-lumière with a lens of about 12 inch focus at B, a tank of ammonio-cupric sulphate in front of that, and in the focus of the lens a little bottle containing the substance supported in a rotating stand, C, so arranged with a "click" that one bottle after another could be brought rapidly into an identical position.

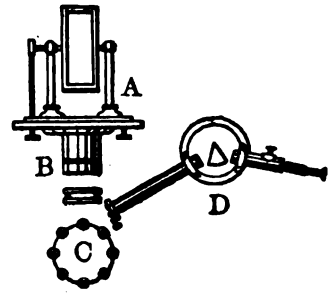
A Browning's one-prism spectroscope was then employed at D to examine the fluorescent light.

If now we fuse a portion of this substance with paraffin and allow it to cool in a thick layer on glass, and examine the light which it will transmit, we shall find that it yields an absorption-spectrum such as is shown in Fig. 3. First comes a relatively narrow and sharply defined band about F, then a very broad and less sharply defined line which contains two maxima of absorption, one about 10·1, and the other about 10·9, of the scale. Lastly, we have a yet more indefinite band about 12·5 reaching to G, and connected by a shade of slight general absorption with the point about 14 of the scale, above which the absorption is total.

The detail of the method of observation here employed is illustrated in Fig. 4, where A is the port-lumière, B a lens of 12-inch focus, C a tank of ammonio-cupric sulphate, D the object to be examined, and E the spectrocope.

These absorption-bands are not only to be seen in the mixture of the above-described body, which I may as well call thallene hereafter to avoid circumlocution, with paraffin, but also in the thallene alone when fused into a thin film by heating between two pieces of mica, and even in paper coated with a mixture of thallene and demar varnish.

FIG. 2.



If now a pure spectrum of sunlight is thrown on a screen of paper coated with the mixture of thallene and varnish last mentioned, it will be observed that a strong fluorescence is excited by all the rays above 8·5 of the scale, but having decided maxima corresponding with the absorption-bands shown in Fig. 3, and a very intense fluorescence of a rich green colour beginning about 14 where the absorption is total. Below this point the fluorescent light combined with that of the spectrum gives a white ground on which the Fraünhofer lines show with remarkable distinctness. The two H lines come out beautifully on the bright green above 14, and with prisms

* The scale used for all these drawings of spectra is that introduced by Bunsen, with millimetre divisions.

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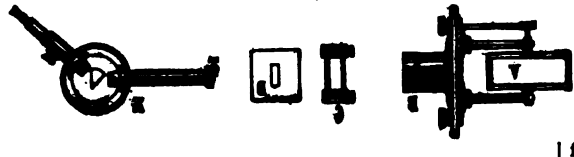
and lenses of quartz the spectrum lines can be seen to a great distance above always on a bright green ground.

As a screen on which to project and study the lines of the extra violet spectrum, either of sunlight or of various elements as described by Stokes,* this substance applied as above seems to exceed very decidedly in brilliancy of effect the peculiar uranium phosphate used by that investigator.

In fact, if, with a brush filled with what we might call this thallene varnish, we write or paint words, or leaves of flowers and the like on a card, and then view it by light which has passed through cobalt glass, the writing or figures seems to be self luminous, so bright is its fluorescence, exceeding even that of the platino-cyanide of barium, which was heretofore the most brilliant solid in this respect. I have just prepared in this way, for a lecture illustration, a flower some 10 feet across, using the above material to paint the leaves and buds, and another to be presently described for the petals, and find that with a lime-light lantern and cobalt glass it lights up in a very surprising manner. With an electric light of course the effect is still better.

In a lecture which I delivered last week (Nov. 6) in the Opera-house in Philadelphia, which seats 3500 auditors, I used a screen 8 feet long by 2 feet wide coated with this substance, and placing it beyond the violet end of a

FIG. 4.



spectrum thrown from an electric light with 60 Bunsen's cells and two bisulphide of carbon prisms, I found that many of the lines of copper, silver, magnesium, and other metals which were invisible on a screen of paper, come out so strongly that they were plainly viewed by every individual in the audience which filled the building on that occasion.

FIG. 5.

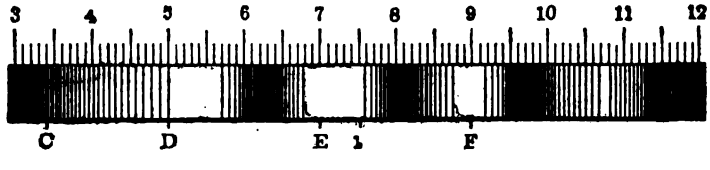
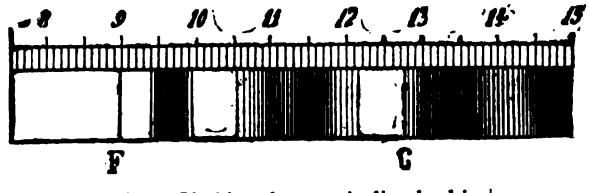


FIG. 6.



Thallene in Solution.—If this substance is dissolved in benzol which will take up at the ordinary temperature about 1 part to 150, a rich yellow liquid is obtained fluorescing with a blue colour and considerable intensity; and when this light is examined with the spectroscope it is found to resolve itself into a spectrum which is indicated below in Fig. 5. Comparing this with Fig. 1, and bearing in mind the correction required in the first band of that figure, it will be seen that in the spectrum of the fluorescent light given by the solution, all the bands are moved towards the more refrangible end of the spectrum.

Thus in the spectrum of the solid we have the centres of the principal bright bands at 6·8 and 8·4, and in that of the liquid at 7·2 and 8·9. In addition to this we perceive that a new bright band has made its appearance at 10·7. On careful examination of the solid, however, in a very strong light, and with a plate of violet glass added to the ammonio-cupric sulphate tank at C (Fig. 4), it appears that a corresponding band exists at about 9·8, though it is very faint. If now we change the solvent to chloroform, in which the thallene dissolves to about the same extent as in benzole, we find the displacement of bands still the same, or not appreciably different.

If, however, we use ether, which dissolves but a small amount, we find the bands displaced yet further up; the principal bright bands, which in the solid are at 6·8 and 8·4, in the benzol solution at 7·2 and 8·9, are in the ethereal solution at 7·4 and 9·2. The spectrum of the solution in alcohol, which dissolves but about 1 part to 12,000, is very much like that of the ethereal solution, as is also the spectrum given similarly with solution in turpentine; that in olive oil is between the solutions in benzole and ether in the upper displacement of its bands.

On the other hand, a solution in carbon-bisulphide shows a displacement of the bands only about half as great as that observed with the solution in benzole.

In all cases of solution we find an elevation of the bright bands in the spectrum; and it is without doubt to this, mainly, that is due the general change in the colour of the fluorescent light, from green in the solid, to blue in all of the solutions.

If now we observe the solutions in the manner indicated in Fig. 4 (and for this purpose I find it very convenient to place them in bottles of white glass of one ounce capacity, these bottles forming cylindrical lenses of a convenient focal length to throw a large amount of light into the slit of the spectroscope), we shall find that the absorption-bands, like those of fluorescence, are displaced upwards, and to a similar degree, without, as a rule, any other change.

This is shown in Fig. 6, which represents the absorption-spectrum of the solution of thallene in benzole.

In the case of the solutions in carbon-bisulphide and in turpentine, it should be observed that the band nearest to F is entirely, or almost entirely, wanting, while the other two are well defined and very strong.

When a glass tank is filled with one of these solutions, and a pure spectrum is projected upon its vertical side, distinct maxima of fluorescence are observed in places corresponding with the absorption-bands, exactly as was the case when the solid thallene was used similarly as a screen, the maxima now, of course, coinciding with the displaced absorption-bands of the solution.

On looking down into the tank, long trails of fluorescent light are seen running into the solution at each maximum, these varying in tint from green in the band near to F, blue in the next, then blue-green, and in the uppermost a purplish blue.

All the actions which have been heretofore described with this body find a parallel in impure anthracene (*i.e.*, chrysogen), except that the absorption-band near F is not lost or diminished by solution in carbon-bisulphide or turpentine, and that it shows no band of fluorescence corresponding with the uppermost one of thallene.

Quite early in my observations on thallene I had noticed that its solutions, as also those of anthracene, when exposed for a short time to sunlight, ceased to give any bands of absorption, and as soon as I had established with anthracene that this was connected with the destruction and removal of a companion body (chrysogen), I tried the effect of a similar treatment upon a benzole solution of

* *Phil. Trans.*, 1862, ii., p. 602.

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thallene. If a solution of this body in benzole is exposed, cold, to bright sunlight for five minutes, the band near F disappears, but it requires an exposure of at least half an hour to remove the other bands. Using a hot solution, and crystallising out the material on cooling, I found that more than two hours were needed to produce thoroughly a change presently to be described, and a much longer time with a cold solution; I therefore had recourse to a large burning-glass of about 16" diameter and 3 feet focus, which was in our cabinet, and found that an exposure of ten minutes near its focus was enough to modify a 4-oz. flask, full of hot saturated solution. After such treatment the solution shows no absorption-bands, and only a total absorption above 14·5; and when, on cooling, crystals are separated, they are seen to have lost their yellow colour and green fluorescence, and are of a slightly leaden tint, and fluoresce bright blue. The spectrum of this fluorescent light shows an upward displacement of the bands a little greater than that given by the solution in ether.

To indicate the body in this condition, I would propose the name "petrollucene."

When a solution of this substance in benzole is examined, by allowing a pure spectrum to fall upon it, the maximum corresponding to the lower absorption-band is found to be entirely wanting; but the two upper maxima, one a little below G, and the other half-way between G and H, are still strongly shown, and have long trails of light running from them far into the solution.

Beside certain additions, which it will be observed that I have made to the actions of chrysogen given in a previous paper (see CHEMICAL NEWS, vol. xxvi., p. 199), two errors should be corrected. On page 201, first column, fourth line from foot, "green" should be "blue;" and on the second column of the same page, near the end of the fourth paragraph, "700° F." should be "460° F."

ADULTERATION OF CHEMICALS.

ACETIC acid is frequently weakened with water, and adulterated with sulphuric ether. Six samples tested with chloride of barium gave a precipitate of sulphate of barium in varying proportions.

Muriatic acid and sulphuric acid, sold as chemically pure, have both been found contaminated; the former with arsenious and sulphurous acids, the latter with a large proportion of sulphate of lead.

Tartaric acid has been met with containing 50 per cent of sulphate of magnesia. Alum is also said to be used as an adulterant, but the reporter had not met with a specimen.

Alum frequently contains iron, probably arising from carelessness in the manufacture. The presence of free acid has also been noticed, especially in the English article.

Carbonate of ammonia is sometimes substituted by a compound made from solution of ammonia, glue, and bicarbonate of soda, which forms when dry a hard translucent mass, resembling genuine carbonate.

Muriate of ammonia is sometimes met with of very poor quality; iron is often visible on the surface and becomes still more so when dissolved. The report recommends that the purified granular salt should be the only one sold at the dispensing counter.

Black sulphuret of antimony has been met with containing sulphite of lead (galena), quartz (30 to 40 per cent), clay, &c. A good article, however, is procurable.

Powdered arsenic is sometimes adulterated with sulphate of lime or sulphate of baryta; the pharmacist is, therefore, recommended to purchase the lump arsenious acid.

Bismuth (metal) generally contains arsenic. An instance is mentioned in the report where 400 lbs. of antimony were sold by a broker to a manufacturer for bismuth. Fortunately for the latter, he detected the error before the transaction was completed.

Subnitrate of bismuth has been reported as adulterated with 20 per cent of phosphate of lime; but it is believed that the salt made in the United States by the principal manufacturers is free from adulteration.

Citrate of iron and quinine is seldom found made strictly according to the United States formula, which does not produce a sufficiently soluble salt. Some manufacturers, therefore, add citrate of ammonia to make it soluble, and others leave out a considerable portion of the quinine to accomplish the same end. There is also a probability that in some cases cinchonine is substituted for the quinine.

Chloral hydrate has been met with containing the alcoholate. The tests pointed out are the difference in boiling-point, sulphuric acid, which leaves pure hydrate colourless, but turns alcoholate brown, and nitric acid, which gives little or no reaction with hydrate, but reacts violently with alcoholate, giving off nitrous oxide gas.

Chloride of calcium has been noticed at Chicago with a large excess of caustic lime, and it is known to have been sold in crystals without any allowance made.

Chloroform is sometimes met with diluted with alcohol, and sometimes not sufficiently purified, and, therefore, unfit for inhalation. There is also reason to believe that partially decomposed chloroform has been sold through ignorance on the part of the dispenser. Nitrate of silver is useful in detecting this decomposition, by giving a precipitate of chloride of silver with the liberated chlorine.

Cream of tartar is grossly adulterated, and the distinctive terms are said to be well known to mean varying proportions of *terra alba* and cream of tartar.

Epsom salt has been substituted in the Western market by finely crystallised Glauber's salt. As the prices, however, are now about the same, this is not likely to recur.

Ether is sometimes sold containing a large proportion of alcohol. This may probably arise from the druggist dispensing photographic concentrated ether, made to contain alcohol in order to dissolve the gun-cotton.

Iodoform has been noticed of a light canary colour, a considerable portion being insoluble in ether; probably iodate of lime.

Acetate of lead has been in the market containing a large percentage of crystallised nitrate of lead; one lot was offered, to a maker of preparations for the hair, as "damaged," which proved to be damaged sulphate of zinc, in lumps.

Precipitated carbonate of lime has been offered containing sufficient iron to give it a light fawn colour; supposed to be ordinary chalk, dressed.

Sulphate of morphia is frequently open to suspicion. In one case the sample did not contain any morphia; placed on a red-hot plate, it did not seem to lose any weight, and it was insoluble in water. A fraud in which sulphate of quinine was put into sulphate of morphia bottles has been lately detected in New York.

Phosphorus, according to Dr. Rademaker, sometimes contains arsenic.

Bromide of potassium has been observed to contain a considerable quantity of water of hydration.

Iodide of potassium is often adulterated with the bromide; some made in New York was found to contain carbonates in considerable quantity.

Sulphate of quinine has many adulterants; among them sulphate of lime; cinchonine, sold as "sweet quinine" or as "cinchoquinine;" muriate of cinchonine, sold as "light sulphate of quinine" and as "French quinine," salicine, &c.

Rochelle salt has been offered for salt containing at least 25 per cent of sulphate of soda.

Santonine was seen last year, in the New York market, contaminated with small particles of mica. This fraud may easily be detected by placing the suspected sample on a hot plate; the santonine will disappear and leave the mica.

Nitrate of silver (made for the Government), which contained 5 per cent of copper, was sold in Chicago.

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Pieces could be picked out emerald-green in colour; it appeared to have been made by simply dissolving coin or other alloy of silver in nitric acid, and crystallising without any attempt at purification.

Precipitated sulphur is reported as usually free from sulphate of lime, and the United States pharmacist is congratulated on this superiority to the English article; but a proportion of 50 per cent of gypsum in flowers of sulphur is reported as having been noticed, and sometimes ground sulphur is sold for the sublimed.

Tartar emetic has been met with containing 11 per cent of cream of tartar.

Spices, on account of their widely extended use, are largely adulterated, and some startling revelations might be made if a spice miller could be persuaded to disgorge his ill-gotten knowledge. The only safe way to get pure powdered drugs is to pay a good price, and buy from conscientious persons who are above suspicion.

Cochineal is adulterated with sulphate of barytes, a heavy white powder, which, when shaken with the insects, lodges in the wrinkles and crevices on the surface of the body. The weight is thus increased sometimes from 15 to 25 per cent.

Balsam of copaiba is often mixed, and sometimes found entirely fictitious, being composed of a mixture of castor-oil, resin, and oil of copaiba. Powdered ipecacuanha is sometimes so adulterated and weakened that tartar emetic is necessary to strengthen it. Oil of lemon mixed with 30 per cent of fixed oil has been met with.

Powdered opium is often mixed with powdered extract of liquorice. In fact, some dealers uniformly send to the grinders a certain proportion of liquorice with the opium, so that they might be ground together. Powdered rhubarb is frequently adulterated with curcuma. Sometimes senega root is mixed with cypripedium.

Castile soap frequently contains an undue proportion of water. It has been met with containing as much as 30 per cent. Acetic acid is also mixed with water, acidulated with dilute sulphuric acid.

Subnitrate of bismuth has been found mixed with phosphate of lime to the extent of 20 per cent; and citrate of iron and quinine is adulterated with citrate of ammonia, and contains less quinine than called for, 10 or 15 per cent instead of 25 per cent. Quinine itself is frequently met with mixed with cinchona, muriate of cinchona, and salicine.

Santonine has been found adulterated with small particles of mica, and cream of tartar frequently mixed with tartar emetic. Cream of tartar is grossly adulterated; the terms "strictly pure, pure, No. 1 and No 2," being used to indicate varying proportions of cream of tartar and *terra alba*, the latter material being largely imported from Europe for the express purpose of adulterating, the importations amounting to many tons annually.

Chloroform is sometimes diluted with alcohol, and iodide of potash in crystals mixed with bromide, and occasionally with bicarbonate of potash. Solid extracts are also much adulterated.

In the manufacture of syrup, a considerable portion of the sugar is replaced by glucose, especially in making fruit syrups.—*Proceedings of the American Pharmaceutical Association.*

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

General Monthly Meeting, December 2, 1872.

SIR HENRY HOLLAND, Bart., M.D., D.C.L., F.R.S., President, in the Chair.

THOMAS Thompson, jun., Esq., and Sidney Waters, Esq., were elected as Members of the Royal Institution. The following lecture arrangements for the ensuing season were announced:—

Christmas Lectures (adapted to a Juvenile Auditory).

Professor Odling, M.A., F.R.S. Six lectures "On Air and Gas," on Dec. 28 (Saturday), Dec. 31, 1872; Jan. 2, 4, 7, 9, 1873. Before Easter, 1873.—Professor Rutherford, M.D., F.R.S.E. Twelve lectures "On the Forces and Motions of the Body," on Tuesdays, Jan. 14 to April 1. Dr. Debus, F.R.S. Three lectures "On Oxidation," on Thursdays, Jan. 16, 23, 30. Dr. H. E. Armstrong, F.C.S. Four lectures "On the Artificial Formation of Organic Substances," on Thursdays, Feb. 6 to Feb. 27. A. Vernon Harcourt, Esq., M.A., F.R.S. Five lectures "On the Chemistry of Coal and its Products," on Thursdays, March 6 to April 3. Edward A. Freeman, Esq., D.C.L. Six lectures "On the Comparative Political Institutions of Different Nations," on Saturdays, Jan. 18 to Feb. 22. Professor W. K. Clifford, M.A. Three lectures "On the Philosophy of the Pure Sciences," on Saturdays, March 1, 8, 15. Professor Max Müller, LL.D. Three lectures "On Darwin's Philosophy of Language," on Saturdays, March 22, 29, and April 5. After Easter.—John Morley, Esq. Three lectures "On the Limits of the Historic Method," on Tuesdays, April 22 to May 6. J. H. Parker, Esq., C.B. Four lectures "On the Evidence for the Traditional History of Rome from Existing Architectural Remains," on Tuesdays, May 13, 20, 27, and June 3. Professor Tyndall, LL.D., F.R.S. Six lectures, on Thursdays, April 24 to June 5. Professor Odling, M.A., F.R.S. Four lectures, on Saturdays, April 26 to May 17. Edward Dannreuther, Esq. Three lectures "On the Development of Music in Connection with the Drama," on Saturdays, May 24, 31, and June 7.

The Friday Evening Meetings will commence on January 17.

Friday Evening Discourses during the Season will probably be given by Wm. Spottiswoode, Esq., the Rev. Professor T. R. Birks, Edward Dannreuther, Esq., R. H. Scott, Esq., Robert Sabine, Esq., Sir H. Rawlinson, K.C.B., Professor Clerk Maxwell, James Dewar, Esq., E. J. Reed, Esq., C.B., J. Emerson Reynolds, Esq., Professor W. K. Clifford, Professor Tyndall, Lord Lindsay, Professor Odling, and others.

The presents received since the last Meeting were laid on the table, and the thanks of the Members returned for the same.

MISCELLANEOUS.

The Royal Society.—At the annual meeting of the Royal Society, held at Burlington House on November 30, the following gentlemen were appointed officers and council for the ensuing year:—*President*—Sir George Biddell Airy, K.C.B., M.A., D.C.L., LL.D., Astronomer Royal. *Treasurer*—William Spottiswoode, M.A. *Secretaries*—Professor George Gabriel Stokes, M.A., D.C.L., LL.D.; Professor Thomas Henry Huxley, LL.D. *Foreign Secretary*—Professor William Hallowes Miller, M.A., LL.D. *Other Members of the Council*—George James Allman, M.D.; Sir B. C. Brodie, Bart., M.A., D.C.L.; George Busk, F.R.C.S.; Professor Robert Bellamy Clifton, M.A.; James Fergusson, D.C.L.; Thomas Archer Hirst, Ph.D.; J. Dalton Hooker, C.B., D.C.L., LL.D.; Joseph Prestwich, V.P.G.S.,; Rear-Admiral G. H. Richards, C.B.; Professor H. Enfield Roscoe, B.A., Ph.D.; Philip Lutley Sclater, M.A.; William Sharpey, M.D., LL.D.; Francis Sibson, M.D.; Major-Gen. R. Strachey, R.E., C.S.I.; Isaac Todhunter, M.A.; Sir Charles Wheatstone, D.C.L.

Royal Institution.—The two Actonian Prizes of £105 have been awarded by the Managers of the Royal Institution to the Rev. George Henslow and to Mr. B. Thomson Lowne, for Essays "On the Theory of the Evolution of Living Things."

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CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, November 25, 1872.

This number is entirely devoted to the general annual meeting of the Academy, at which the prizes are distributed, and reports read concerning them.

Les Mondes, November 28, 1872.

Annual Public Meeting of the Academy of Sciences; Distribution of the Prizes for 1870 and 1871.—From the contents of this paper we abstract the following particulars:—The Lalande prize for astronomy has been given to Mr. Huggins, as an acknowledgment of his researches on the physical constitution of the stars, planets, comets, and nebulæ. The Jecker prize (chemistry) has been given to MM. De Clermont, Gal, and Grimaux; to each of these has been given the sum of 7000 francs (£280), as an acknowledgment for their chemical researches. The Barbier prize has been given to M. Personne for his researches on chloral. The prizes for 1871 relating to chemistry and collateral sciences have been distributed as follows:—The Jecker prize to Dr. Schützenberger, as an acknowledgment for his labours in organic chemistry. The Barbier prize to Dr. Duquesnel, for a memoir on crystallised aconitine. The Montyon prize and 2500 francs (£100) to M. Goldenberg, for sanitary improvements made in his manufactory. 2000 francs to M. Louvel for his process of preserving grain in vacuum.

Obituary.—Professor Klebsch, of Göttingen, one of the most eminent mathematicians of the day, has just died at the early age of forty; the deceased was a lso well known for his studies in astronomy and physics.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 17, 1872.

This number opens with an address of Dr. Liebreich, congratulating the President (Dr. A. W. Hofmann) and the members of the Society on the fifth anniversary of the foundation of this society, already one of the most successful scientific societies established in Germany; the speaker gives a review of the history of the past lustrum, and pays a well-deserved tribute to Dr. A. W. Hofmann, to whose energy the success of the society is in a great measure due. Dr. Oppenheim proposed that a subscription list should be opened for the benefit of the orphans of the late J. C. Brough; the amount subscribed up to November 18, was 158 thalers = £23 14s.

The following original papers and memoirs are contained in this number:—

Researches on the Uric Acid Group.—M. Nencki.—After referring to his former researches on this subject, the author states that, when barbituric acid is treated with cyanogen gas, there is formed cyan-malonyl-urea, $C_6H_4N_4O_5$; the formation of this body from barbituric acid is simply due to the addition thereto of cyanogen, and takes place according to the following formula:—

$$C_4H_4N_2O_3 + C_2N_2 = C_6H_4N_4O_5.$$

Cyan-malonyl-urea is not decomposed by boiling with water; it is a solid crystalline substance, which, when heated to 240°, gives a small sublimate, but is mainly carbonised and decomposed. Strong sulphuric acid decomposes cyan-malonyl-urea at 100°; carbonic acid is evolved, and several new products formed. By the action of caustic potassa solution, a new acid is formed, which the author terms cyan-uromalic acid; the potassa salt of this acid has the formula $C_6H_3KN_4O_5$. The free acid is a solid substance, difficultly soluble in water, but this substance is an unstable compound, because it is slowly decomposed by contact of air, hydrocyanic acid being given off; the formula of the free acid is $C_6H_4N_4O_5$. The acid alluded to is, according to the author's researches (compared with those of Baeyer, *Ann. d. Chem. u. Pharm.*, vol. cxxxv., p. 312), identical with malobiuric acid—

$$N_2\left\{\begin{matrix}(CO)_2\\C_2H_2O_2\\H_2\end{matrix}\right.$$

Dehydration (Wasserentziehung) as Taking Place in the Animal Organism.—M. Nencki.—Reserved for full translation; an observation also applying to the following essay:—

On Ultramarine.—C. Unger.

On Nitro-Naphthalines.—A. de Aguiar.—This exhaustive essay treats on dinitro-naphthalin-α, which is soluble in glacial acetic acid; it is a yellow-coloured crystalline substance, and, when treated with strong nitric acid, yields some trinitro-naphthalin, but chiefly tetra-nitro-naphthalin-α, and also nitro-phthalic acid, $C_6H_3(NO_2)COOH$. The crystallographical features of this body are described at length, and illustrated by woodcuts; the chemical properties agree with those described by Marignac. Nitro-phthalate of baryta is a crystalline salt barely soluble in water; it contains no water of crystallisation; formula—

$$C_6H_3(NO_2)\left\{\begin{matrix}CO.O\\CO.O\end{matrix}\right\}Ba.$$

Nitro-phthalate of silver is an amorphous compound, soluble in acids, and exploding when heated; formula—

$$C_6H_3(NO_2)\left\{\begin{matrix}CO.O\\CO.O\end{matrix}\right\}Ag_2.$$

A considerable portion of this essay is devoted to a comparative review of the author's and Dr. Beilstein's researches on this subject; the modes of preparation of the above compounds are also exhaustively described.

On Triphenyl-Methan.—A. Kekulé and A. Franchimont.—In the introduction to this paper the authors observe that it has become customary to view the hydrocarbons of the benzol series as derivatives from benzol, for the hydrogen atoms of which have been substituted monovalent *(einwerthige)* alcohol radicals; instead of this view being taken, the hydrocarbons just mentioned might be referred to substances of the fatty bodies, by considering that for a certain number of hydrogen atoms of these, remnants *(reste)* of benzol have been substituted. This has already been done for the alcohols, aldehydes, and acids of the aromatic series, and when applied to the aromatic hydrocarbons starting from methan, the simplest hydrocarbon of the group of the fatty bodies, the following series will be obtained:—

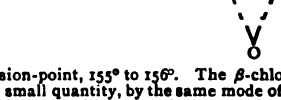
$CH_3.C_6H_5$, phenyl-methan, synonymous with toluol.
$CH_2.(C_6H_5)_2$, diphenyl-methan, " " benzyl-benzol.
$CH.(C_6H_5)_3$, triphenyl-methan.
$C.(C_6H_5)_4$, tetraphenyl-methan.

The preparation of triphenyl-methan from mercuro-diphenyl is then described at length; the pure substance is a solid crystalline body, fusing at 92·5°, boiling at 355°, insoluble in water, readily soluble in ether, boiling alcohol, and boiling benzol. Triphenyl-methan forms with benzol a solid crystalline combination, which fuses at 76°, the benzol being gradually eliminated by the application of a higher temperature, so that at 92·5° there is only triphenyl-methan left; the simplest formula of this body is $C_{19}H_{16}$, while its constitutional formula is that quoted above. With fuming sulphuric acid, triphenyl-methan forms a sulpho acid; formula, $CH(C_6H_4.SO_3H)_3$; the baryta salt of this acid is soluble in water, but is precipitated from this solution by alcohol.

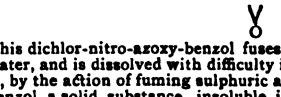
Benzophenon Chloride, and the Formation of Anthrachinon by the Preparation of Benzophenon.—A. Kekulé and A. Franchimont.—The preparation of benzophenon chloride, a rather difficult operation, is first described at length. In pure state, the body is a colourless very refractive fluid; sp. gr. at 18·5° = 1·235; boiling-point, at ordinary barometric pressure, from 298° to 300°, and, with the thermometer fully in the vapour, 305°; it is slowly decomposed by cold water, rapidly so by hot. The researches on the reactions of this body are not yet finished, but the authors observe that, while preparing benzophenon, some anthrachinon was formed; the formation of this body (benzophenon being prepared by the dry distillation of benzoate of lime) is considered due, not to any impurity in the substances employed, but to a peculiar condensation of benzoic acid, elucidated by the fact that anthrachinon has the composition of a second hydrate of benzoic acid—

$$2C_7H_6O_2 - H_2O = C_{14}H_{10}O_3, \text{ benzoyl anhydride.}$$
$$C_{14}H_{10}O_3 = H_2O = C_{14}H_8O_2, \text{ anthrachinon.}$$

Chlorated Azo-Derivatives of Benzol.—K. Heumann.—The researches recorded in this memoir have been made to ascertain how far the differences existing between the two isomeric modifications of monochlor-nitro-benzol are carried over to the derivatives of these bodies; for this purpose α-chlor-nitro-benzol has been treated by the author with caustic potassa solution, the result of the operation, after purifying the substance formed, being the production of a compound, $C_{12}H_6Cl_2N_2O$, dichlor-azoxy-benzol; structural formula—



fusion-point, 155° to 156°. The β-chlor-nitro-benzol yields, although in small quantity, by the same mode of treatment, the same substance, which is readily nitrated, thereby yielding a new compound—



This dichlor-nitro-azoxy-benzol fuses at 134°, is entirely insoluble in water, and is dissolved with difficulty in alcohol; it is crystalline, and is, by the action of fuming sulphuric acid, converted into dichlor-azo-benzol, a solid substance, insoluble in water, somewhat soluble in boiling alcohol; fusion-point, 183°.

Action of Sodium upon Chlorated Nitro-Compounds.—Dr. A. W. Hofmann and A. Geyger.—This essay contains the account of a series of researches, which were not completed, and also relates to solid chlor-nitro-benzol (fusion-point, 83°), and the action of sodium upon the ethereal solution of that body. The authors obtained, in addition to dichlor-oxyazo-benzol, $C_{12}H_6Cl_2N_2O$, a hydro-compound,

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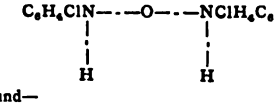
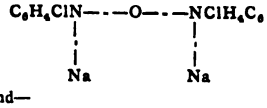
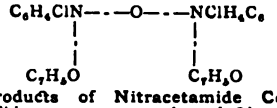
and they presume that a sodium compound, as well as a benzoyl, may exist, but these are not actually obtained in pure state by experiment. The following formulæ exhibit the constitution of these bodies:—
Hydro-compound—



Sodium-compound—



Benzoyl-compound—



Reduction-Products of Nitracetamide Combinations.—F. Hobrecker.—This essay treats on the reduction-products of the nitracetamide combinations when treated with granulated tin and hydrochloric acid; when nitracetamido-benzol is treated in that manner, the result is the formation of diamido-benzol, fusing at 140°, and forming, with platinic chloride, the compound—

$$C_6H_4(NH_2)_2(HCl)_2.PtCl_4.$$

When nitracetamido-toluol is treated as mentioned, the result is the formation of ethenyl-toluylen-diamin, which also combines with platinic chloride. By reduction, nitracetamido-xylol yields a new base, which, in free state, is amorphous, but the chlorhydrate is a crystalline body; formula, $C_{10}H_{12}N_2.HCl$. Composition of platinum salt, $C_{20}H_{24}N_4,(HCl)_2,PtCl_4$. The author further treats on ethenyl-diamido-xylol-urethan (ethenyl-xylen-diamin-urethan) and on ethenyl-triamido-benzol.

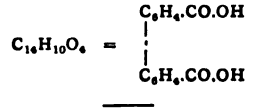
Existence and Dissociation of Tetrachloride of Sulphur.—A. Michaelis and O. Schifferdecher.—This essay, elucidated by a large number of formulæ, treats exhaustively, and with copious references to the labours of a large number of scientific chemists on this same subject, on the best methods of preparation, the properties, and products resulting from the dissociation by heat of the combinations of sulphur and chlorine.

Action of Alkaline Copper Solution on Cane Sugar and on Mixtures of Cane Sugar and Grape Sugar.—C. Scheibler.—The contents of this paper refer to the fact that the researches made by E. Feltz (see CHEMICAL NEWS, vol. xxvi., p. 215) on this subject are not new, since in the year 1869 the author (see *Zeitschrift fur die Ruben Zuckerindustrie im Zollverein*, vol. xix., p. 386), called attention to the reactions alluded to by Feltz.

Action of Perchloride of Phosphorus upon Sulpho Chlorides according to G. A. Barbaglia and A. Kekulé.—A. Michaelis.—This paper, elucidated by a large number of formulæ, contains a discussion on some of the statements made by Barbaglia and Kekulé in an essay published by them on this subject.

New Hydrocarbon Isomeric with Anthracen.—E. Schmidt.—After first briefly referring to Graebe's paper (see CHEMICAL NEWS, vol. xxvi., p. 252), the author describes at length his discovery, in crude mononitro-anthracen, of a new hydrocarbon belonging to the $C_{14}H_{10}$ series, which differs from anthracen, as well as from the body described by Graebe. This new hydrocarbon is a solid crystalline body, fusing at 247° (anthracen at 213°; Graebe's hydrocarbon at 105°); it is insoluble in cold, but somewhat soluble in boiling, alcohol, and readily soluble in benzol, sulphide of carbon, and chloroform. This hydrocarbon combines with picric acid, is not acted upon by nitric acid of sp. gr. 1·2, but readily so by the strongest nitric acid; with sulphuric acid, this substance forms a sulpho-acid.

Another New Hydrocarbon from Coal-Tar.—E. Ostermayer and R. Fittig.—The authors record at length, and elucidate by a series of formulæ, their researches, the result of which is the discovery of another hydrocarbon in coal-tar, or, rather, in one of the heavier oils (boiling above 300°) obtained from tar. The new body is also a solid substance, fusing at from 97° to 99°; boiling-point, above 300°; it combines with picric acid, and forms, by oxidation, a chinon differing from anthrachinon, and yielding, by oxidation, diphenic acid—



Archives Neerlandaises des Sciences Exactes et Naturelles, Vol. vii., No. 4, 1872.

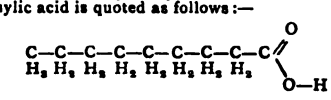
In addition to original papers relating to mathematics, natural history, and experimental physiology, this number contains the following original memoirs relating to chemistry and collateral sciences:—

The Physometer, a New Instrument for the purpose of Determining Variable Volumes of Air or other Substances, and more particularly the so-called Swimming-Bladder of Fishes.—P. Harting.—The contents of this exhaustive monograph, illustrated by several engravings, not only detail the description of the physometer invented by the author, but also the history of the various opinions held by scientific men on the functions of the swimming-bladder of the fishes, and further, a series of minute experiments to illustrate the action of this organ, and of exhibiting to what applications the physometer may be employed.

Although not belonging to chemistry, we call attention to the following essay:—

Action of a Constant Electrical Current upon the Nervus Vagus (Pneumogastric Nerve).—F. C. Donders.

On Nonylic Acid (probably) Normal.—A. P. N. Franchimont and Th. Zincke.—The introduction to this essay contains, first, reference to the other researches of the authors connected with this subject, and, next, a *resumé* of the labours of others on nonylic, also known as pelargonic, acid, having been discovered in the distilled water obtained from the *Pelargonium roseum*. Nonylic acid, $C_9H_{18}O_2$, is obtained from octylic alcohol by a process described at length. The acid is a colourless, oleaginous liquid, boiling at from 253° to 255°; sp. gr. at 17·5° = 0·9065; it is hardly soluble in water, solidifies at a low temperature, and melts again at 10°, but the acid obtained by decomposing the baryta salt thereof (an exceedingly pure acid) was found to solidify at 11·5, and to melt again at from 12° to 12·5. The authors describe, at great length, several of the salts of this acid, most of which are crystalline when obtained from their alcoholic solution. The methyl-nonylic and ethyl-nonylic ethers are also described; the formula of nonylic acid is quoted as follows:—



There is added tc this memoir the following tabulated form:—

Names of the Acids.	Boiling-Point of the Acids.	Boiling-Point of the Ethylic Ethers.
Acetic	118° (Linnemann)	77° (Linnemann)
Propionic ..	140·6° ,,	98·8° ,,
Butyric	162·0° ,,	121° ,,
Valerianic ..	184° (Lieben and Rossi)	Not known.
Caproic	204·5°—205° ,,	166·5—167·5° (Fr. and *Z.*)
Heptylic ..	210°—222° (Schorlemmer) / 223°—224° (Franchimont)	187°—188° (Franchimont)
Octylic	232°—234° (Zincke)	207°—208° (Fr. and *Z.*)
Nonylic	253°—254° (Fr. and *Z.*)	227°—228° ,,
Capric	268°—270° (Grimm)	243° ? (Fincker)

And, further, a discussion on the question whether the nonylic acid prepared by the authors is, or is not, identical with the pelargonic acid of older days. While there is, on careful comparison of the results of the older researches and analysis, every reason to believe that the acids alluded to are really identical, the authors prefer to leave this question until they have finished their investigation of the nonylic acid prepared from the essential oil of rue (*Ruta graveolens*).

Researches on the Liquid Emitted by the Larvæ of a Cimbex.—A. J. van Rossum.—In the introduction to this paper, the author communicates some entomological particulars relating to the larvæ of the *Tenthredinæ*, genus *Cimbex*, which, provided with small lateral apertures, emit through these, with comparatively great force, a coloured fluid to protect themselves from the attacks of ichneumons, birds, &c. This fluid, collected by the author from the living larvæ, has been chemically investigated, and found, while exhibiting a distinctly alkaline reaction, to be mainly a protein or albumenoid compound, which behaves with reagents very much like white of egg. As regards the nature of the colouring matter, it is probably chlorophyll, or some modification thereof. The liquid experimented with was that from the larvæ of *Cimbex connata* and *Cimbex sylvarum*. The author thinks that the fluid acts as a means of defence, more by reason of its viscosity than by reason of its weak alkalinity.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, November 14, 1872.

The only paper in this number collaterally relating to chemistry is—

Use of Tin-Foil instead of Paper for Covering Walls, and on the Process of Applying Colours to that Material.—Daniel and Co.—From the exhaustive account and directions here given, it appears that, for papering rooms, tin-foil offers great advantages, both as regards decoration and durability.

MEETINGS FOR THE WEEK.

MONDAY, Dec. 9th.—Royal Geographical 8.30.
—— Medical, 8.
TUESDAY, 10th.—London Institution, 4.
—— Civil Engineers, 8.
—— Photographic, 8.
WEDNESDAY, 11th.—Society of Arts, 8.
THURSDAY, 12th.—Royal, 8.30.
—— Royal Society Club, 6.
FRIDAY, 13th.—Philosophical Club, 6.
—— Astronomical, 8.
—— Quekett Club, 8.

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Government Control of Telegraphs: Operators' Salaries.
International Telegraphy in Time of War.
General Eardley Wilmot on Telegraphy.
On Ohm's Law and Kirchhoff's Corollaries. By Robert Sabine, C.E. (With Four Woodcuts).
Sir Charles Wheatstone's Automatic System. (With Six Woodcuts).
Cable Signalling. By G. K. Winter, F.R.A.S.
M. Planté's New Secondary Battery. (With Two Woodcuts).
Improved Grove's Battery. By Horatio Yeates. (With Two Woodcuts).
Phenomena of Lightning. By Father Secchi.
Electrical Resistances. By Walter Hall.
Improved Form of Induction Coil.
Magnetic Energy. By M. Cazin.

Students' Column.—Proceedings of Societies.—Electrical Science in Foreign Journals.—Telegraph Share List.—City Notes.—Notes of Appointments in the Service and of Passing Events.—Register of New Patents, &c., &c.

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THE CHEMICAL NEWS.

VOL. XXVI. No. 682.

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PRELIMINARY NOTICE.

ON THE IODO-DERIVATIVES OF THE ORCINS.

By JOHN STENHOUSE, LL.D., F.R.S.

In 1864 (*Journ. Chem. Soc.*, vol. xvii., p. 327) I published an account of teriod-orcin, obtained by the action of iodine protochloride on an aqueous solution of orcin, but I found I was unable by this process to obtain any other iodo-derivative of orcin.

Monoiod-orcin, $C_7H_7IO_2$.—When an ethereal solution containing a molecule of orcin and one of iodine is agitated with dry precipitated mercuric oxide, the colour rapidly disappears and an iod-orcin is formed. On distilling off the ether, and extracting the residue with hot benzol, the iod-orcin separates in the crystalline state on cooling. In this reaction, powdered lead oxide (litharge) may be advantageously substituted for the mercuric oxide, since the lead oxide produced is not dissolved when the residue is extracted with benzol. Two or three alternate crystallisations from benzol and from water suffice to render the iodide pure; but, if mercuric oxide has been used, it is advisable to employ a dilute solution of potassium iodide for the first crystallisation, to prevent the mercuric iodide crystallising out along with the iod-orcin.

Monoiod-orcin, as thus prepared, is a colourless crystalline substance, which melts at about 86°, and decomposes, with evolution of iodine vapours, when heated more strongly. Gently heated with concentrated sulphuric acid, the substance is decomposed and iodine freely liberated. Iod-orcin is only slightly soluble in cold water, but readily in hot water. It is very soluble in ether and in hot alcohol; moderately soluble in benzol and in hot petroleum, crystallising out from the latter almost entirely on cooling; slightly soluble in carbon disulphide. It is quite destitute of the peculiar astringent sweet taste so characteristic of pure orcin.

Monoiodo-resorcin, $C_6H_5IO_2$.—This compound, prepared in a similar manner to the corresponding orcin compounds, is a colourless crystalline substance, closely resembling the iod-orcin in its general characters, but much more soluble in water.

When the monoiod-orcins, in ethereal solution, are again treated with iodine and a metallic oxide, more of the hydrogen is replaced, producing the higher iodo-compounds; these I am at present investigating, and hope, by pushing the action to the fullest extent, to obtain penta-iodo-orcins corresponding to the chlorine and bromine derivatives, of which I have already published an account.

ON THE PRESENT POSITION OF SCIENCE IN RELATION TO THE BRITISH GOVERNMENT.*

By G. GORE, F.R.S.

It is a matter of great importance to this nation, and of special importance to the scientific men of this country, to clearly realise the position which science at present occupies in relation to our Government. That position will probably be further brought to light by the evidence which is now being given by our leading scientific men before the "Royal Commission for the Advancement of Science."

* Read before the Social Science Association, Plymouth, 1872.

For many years science has been of immense practical value to us; it has, by means of its discoveries, originated all our telegraphs, railways, steamships, gas lighting, photography, electro-plating, artillery, and nearly all our great manufactures. It has led to the expenditure of hundreds of millions of pounds upon these and other matters, and at the present time this nation largely exists upon the applied results of scientific discovery. There was a period when we did not possess such evidence of the great value of science; but that time has passed away, and our governing men have had abundant proof of the national importance of scientific discovery, and of the essential dependence of the welfare of this country upon scientific research. It is upon these grounds, therefore, that our Governments are expected to consider their duty with regard to science.

Scientific discovery and research (as distinguished from invention) is *national* work, and it is a duty of the State to provide and pay for it, because the results of it are of immense value, and indispensable to the nation; also, because nearly the whole benefit of it goes to the nation, and scarcely any to the discoverer; and because there exists no other means by which scientific investigators can be paid for their labours.

It is barely credible that, whilst the non-productive classes of the community are justly protected in the enjoyment of titles and material wealth which they have not earned, the greatest scientific workers and benefactors of the nation receive actually no payment for their labours, and the nation in general, and the non-productive classes in particular, reap the pecuniary benefit. The chief benefits of science go to the enrichment of the great manufacturers and capitalists, and finally and permanently to the great landowners, by increasing the value of land. It does not add to the dignity of one class of persons that they should be living largely upon the unpaid labours of another class; and it tends to produce evil feelings between them.

It may be objected that scientific men ought either to sell their discoveries or protect them by means of patents. Neither of these courses are possible. Scientific discoveries, although of such great value, are not saleable things; because they have not been converted by the process of invention into practical shapes, and because they cannot be protected by patent. They cannot be protected, because they are so universal in their applications. A single discovery often originates more than one hundred inventions, as may be readily seen by the number of patents taken out for the application of a single discovered substance, such as gutta-percha or india-rubber. No man could have secured to himself the discovery of the chemical action of light, because of the great number of persons who would have applied it to useful purposes, and used the applications; to claim such a discovery would be a considerable approach towards monopolising the benefit of light itself.

It is only when a discovery has been adapted to some particular use in some special way, by means of invention, that its discoverer can protect a part of it by patent, and reap any pecuniary benefit; and to protect it completely would require it to be applied to all the practical uses of which it is capable, which could only be effected by means of many inventions. Further, the faculties of invention and discovery are rarely united in one man, and it requires a higher quality of mental power to make a discovery, than to apply that discovery to useful purposes by means of invention.

Scientific discoveries, being of universal utility, like the light, the land, the air we breathe, belong, by their very nature, to all the nation. From the moment that a discovery is published, it gets copied into all the scientific publications; it immediately becomes used by teachers for the purposes of instruction, and by inventors generally as a basis for patentable inventions; and in these ways it becomes at once national property, and no law can prevent it.

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It may also be objected that scientific men should not make discoveries if there is no payment for such labour. Many men are impelled by a natural desire to do good, irrespective of payment, whilst others are equally selfish, and live upon the labours of their fellow-creatures; and if such men did not make discoveries we should be without most of the luxuries, comforts, and conveniences of life. Every man who benefits his fellow-men, or labours for the good of the nation, is entitled to means of existence, and the only just course is to provide for his support.

It may further be objected that scientific men should keep their discoveries secret; but that would be worse than useless, because discoveries cost great skill and labour, and when published are of great value to mankind.

The general aspect in which science is viewed by many persons in this country is that of a refined intellectual pursuit, which may be encouraged and honoured for the purpose of maintaining the tone of society, but which must on all occasions be considered as secondary to the more *apparently* practical requirements of national life, and be sacrificed to them; but this is a superficial idea, and has its origin in the low state of scientific knowledge. Science is eminently practical; scientific discovery lies at the very basis of national progress, and is the origin of many of the practical advantages of civilised life. The idea of men being able to honour demonstrable truth is simply an ignorant conceit. Science cannot be honoured by anyone, and the question is, not whether the State shall encourage science as a refined intellectual occupation, but whether our governments will consider the welfare of the nation in its relation to science.

One of the first duties of a Government is to protect its subjects in the enjoyment of their property; but as no law can reserve to discoverers the fruits of their industry, and as scientific discovery is national work, it is clearly a duty of the state to pay for it. It is as certainly its duty to provide and pay for original research as for its military and naval establishments; because the development of the industry and warlike appliances of the nation is quite as important as the maintenance of its means of defence and aggression. The power that has brought into existence new industries is certainly as valuable to this nation as the means of preserving to us the possession of them afterwards; and we must not forget that our great cannon, explosive missiles, and armour-plated ships would not have existed but for the discoveries of scientific men.

Since the last Paris Exhibition an opinion has gradually spread that, in consequence of our neglect of science, foreign nations are supplanting England in her manufactures; but whether this opinion is or is not correct, there can be no doubt that national superiority can only be maintained by being first in the race, and that as a matter of prudence we should not neglect any precaution which is necessary to the welfare of the nation.

The very foundations of science in this country are rapidly being destroyed by the neglect of science by our Governments, and by those who have derived the greatest amount of benefit from it. Original discovery is the basis of all scientific progress. Great discoverers are rare, and the loss of a few of them is a national calamity. The majority of our most able investigators have ceased to make researches because the State does not pay for such labour. Several, also, of our most eminent discoverers have died, and others have not arisen to take their places. The discoveries in chemistry by British chemists, published in the *Journal of the Chemical Society*, have diminished almost to zero; whilst those of foreign chemists have so increased that the journal referred to is almost filled with them. But few first-class investigators are making original researches in this country, and we are rapidly becoming dependent for our progress in scientific arts and manufactures upon knowledge supplied to us by foreign nations.

In all directions, wherever we examine the state of knowledge of science amongst the governing men of this country, we find it very defective, and attended by results seriously injurious to the welfare of the nation. Gentlemen who are comparatively ignorant of science are appointed by our Governments to decide scientific questions. Only recently (May 21st, 1872), a memorial of the British Association, signed by the eminent president, Sir William Thomson, was sent to the Lords of the Treasury, applying for a sum of £150, to continue a series of observations on the tides, upon which the Association had already expended £600 from its own resources, and which was essential to a more complete knowledge of the tides, and consequently to the greater safety of our navy. The reply to this application was most civil; but, putting upon it the most charitable construction, it exhibited a degree of ignorance of the national value of science most painful to contemplate. The reply stated "that their lordships have given their anxious attention to the memorial, and that they are fully sensible of the interesting nature of such investigations; but that they feel that, if they acceded to this request, it would be impossible to refuse to contribute towards the numerous other objects which men of eminence may desire to treat scientifically. Their lordships must, therefore, though with regret, decline to make a promise of assistance towards the present object out of public funds."

Here was a subject of great importance to the national welfare, and which it was the duty of the State, and not that of the British Association, wholly to pay for, treated as if it was only an investigation of an "interesting nature," "which men of eminence may desire to treat scientifically."

Their lordships were apparently not aware that ignorance of the course and height of tides often leads to shipwrecks, and that their refusal of £150 might lead to the loss of some valuable ship; tbey seemed to have forgotten that the loss of the ill-fated *Captain* was due to neglect of science. Such a want of knowledge in any private appointment would be a sufficient reason to remove from his post the responsible person. It is difficult to believe that the Government of a maritime country should be so ignorant of science as to decline to make even a promise of assistance out of the public funds of the small sum of £150 for such an important purpose, whilst it expends immense sums of money upon ships. Their lordships were manifestly unable to appreciate the importance of the application, or to perceive the duty of the State to pay for such labours; and, instead of acting upon the opinion of disinterested men, of the highest eminence in the subject, declined to accede to the request.

Gentlemen who are but little acquainted with science are also appointed by our Government to direct eminent scientific men in scientific matters, and the results, as might be expected, are most unsatisfactory. A recent melancholy instance of this kind, which has degraded our Government in the opinion of other nations, and of all well-instructed persons, is fresh in the memory of the public. Mr. Ayrton, the Chief Commissioner of Works, was placed in authority over the eminent botanist, Dr. Hooker, at Kew Gardens, and presumed to interfere with the management of the hothouses under Dr. Hooker's care. There is scarcely a scientific man in this country who has not frequently suffered from similar ignorant misdirection, but the circumstances have not happened to become public. If governing men possessing the requisite knowledge of science for such posts cannot be obtained, it is clear that those appointed should not be entrusted with the power, nor burthened with the responsibility of directing subjects they do not understand, and the course indicated in such a case is a division of labour, making the scientific officers much more independent than they hitherto have been.

The origin of all these evils lies largely in the defective state of scientific instruction at our old universities and great public schools. Our governing men, having been chiefly educated at those institutions, have been but little instructed in science. In addition to this, science has advanced so greatly during the last few years that

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become an immense department of national life, requiring a special education to understand, and has left our old institutions behind.

The heads of colleges and the head masters of nearly all our grammar schools, having also acquired their learning at our old universities, have been but little, or not at all, educated in science, and in consequence of this, scientific instruction is in a low state throughout nearly the whole scholastic system of the country. Further, the "Endowed Schools Commission," now pursuing its labours, recommends "that all lecturers and teachers" in the various Government schools of this country "shall be appointed and dismissed by the head masters," and that "the said head masters shall have under their control the choice of books, and the method of teaching" in those schools. A result of these provisions will be that the system of appointing gentlemen comparatively ignorant of science to direct teachers of science will be continued, and scientific instruction will continue to be degraded in the grammar schools of this country. These very proposals prove that the gentlemen who made them had not been well instructed in science.

It is manifest that the only foundation of a reliable judgment in scientific affairs is a good knowledge of science, and this can only be obtained by long-continued study and experience. It is also clear that the practice in this country of appointing gentlemen comparatively ignorant of science to legislate for it, and to direct scientific men in Government offices and public schools, is one of the most effectual that could be devised for retarding the progress of the nation in all those matters which depend upon science. If scientific men are to be legislated for and directed, justice requires that it should be by men possessed of adequate scientific knowledge.

To partly remedy this unsatisfactory state of things, we require a State Minister of Science, possessed of scientific knowledge and good administrative ability; a Scientific Council, to advise the Government in all important matters relating to science; and State laboratories for pure scientific research.

The funds for providing State laboratories already exist; the sum of nearly £600,000 has accumulated in the form of fees received by Government for the granting of patents for inventions; and as the discoveries made by scientific men form the materials by means of which those inventions were made, the money thus accumulated may be justly claimed by scientific discoverers as a source from which their labours should be remunerated by the State.

As long as scientific men continue at their own expense to do scientific work which ought to be paid for by the State, so long will the governing and richer classes of this country, impelled by the selfishness which pervades them in common with nearly all mankind, and unenlightened by knowledge of science, neglect the duty of paying for original research, and reap the chief benefits of such labours.

The time has arrived when this great national evil should be made known, and put an end to; and our men of science should present a memorial to our Government, claiming as a matter of justice, necessary for the nation's welfare, that the accumulated fees from patents should be applied to the establishment of a Scientific Department of the State, the erection of State laboratories, and the payment of discoverers for the national work of research.

Should our Government continue to neglect these just claims, and disregard the evidence collected by the "Royal Commission for the Advancement of Science," the decline of original scientific research, which has already commenced, will continue. The probable results of this will be, inventions will become scarce; new trades will not be developed; improvements in agriculture, arts, manufactures, means of defence, and other important matters, will decline; the value of houses and land will diminish; and our commerce will pass into the hands of other nations.

ON THE HISTORY OF OZONE.*

By Professor ODLING, F.R.S.

THE most important points in the history of ozone are the following:—I. Its recognition as a distinct variety of matter or substance, by Schönbein in 1840. II. An inquiry into its nature, made by Marignac in 1845, whereby it was established that the action of ozone on various substances results simply in their oxidation. III. The evidence of different kinds, accumulated by many observers during a period extending from 1845 to 1863, that the matter of ozone is identical with the matter of oxygen. IV. The demonstration by Andrews and Tait in 1860, that ozone is a condensed form of oxygen. V. The recognition by Andrews and Tait in 1860, and interpretation by the speaker in 1861, of the singular fact that, in certain cases, the removal of its constituent ozone from a mixture of ozone and oxygen in unattended by any alteration in the volume of the gas, notwithstanding the considerable oxidation effected by it. VI. The study of the quantitative reactions of ozone by Brodie in 1872; and his establishment of the relationship of ozone to ordinary oxygen, in corroboration of some less exact results obtained by Soret in 1865, as also of a suggestion made by the speaker in 1861.

I.

Ozone was discovered by Schönbein, in 1840, when experimenting with the then newly-invented battery of Sir Wm. Grove,—an instrument still recognised as yielding a current superior, in respect of joint quantity and intensity, to the current yielded by any other electromotor available for general use. Ozone was recognised by Schönbein successively as a minute constituent of the oxygen gas resulting from the electrolysis of water effected by a current of high tension; as a minute constituent of air or oxygen through which electric discharges have taken place; and as a minute constituent of air in which moist phosphorus has been undergoing slow oxidation. To Schönbein then is due the great merit of recognising ozone as a distinct form of matter, having an identity of its own by whatsoever means prepared—as also the merit of discovering the most important means for the production of ozone, and of establishing its principal properties and reactions.

The general properties of ozone are those of an active oxygenant. Thus, like chlorine and peroxide of nitrogen, it bleaches colouring matters, corrodes fabrics, tarnishes or otherwise attacks metals, and liberates iodine from iodide of potassium. Its special properties are its characteristic pungent odour, its destructibility by a moderate heat, and its non-manifestation of any acidulous reaction.

II.

The nature of ozone was at first the subject of much speculation, Schönbein inclining to the view that it was a new elementary body, and a component of nitrogen. But in 1845, Marignac, in a series of most exact experiments, made partly in association with De la Rive, brought the question as to the nature of ozone within a very narrow compass. The experiments of these investigators, in which they established, among other points, that by exposure to the action of ozone, moist silver was converted simply into oxide of silver, and iodide of potassium into its oxidised form of iodate of potash, were susceptible only of one or other of two interpretations—either the interpretation which they themselves put on their results, that the matter of ozone is identical with the matter of oxygen—or, else the interpretation put on their results by Schönbein, that ozone is constituted of oxygen *plus* the elements of water, or in other words, that it is a peroxide of hydrogen. For a long time, experiment seemed quite incompetent to decide between these two views—oppposite conclusions being arrived at almost alternately by the

* Read before the Royal Institution of Great Britain.

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different investigators engaged on the inquiry. Corroboration, however, if any were needed, of the fact that ozone is really formed from oxygen itself with or without water, and not from any trace of nitrogen or other foreign matter that might possibly be present, was afforded by a remarkable experiment conducted by Fremy and Becquerel in 1853, being, indeed, the first recorded quantitative experiment made with ozone. By passing a long series of electric discharges through a given volume of oxygen standing over an aqueous solution of iodide of potassium, MM. Fremy and Becquerel succeeded in causing the whole of this oxygen to assume the form of ozone; as was shown by its ultimate complete absorption by the solution, with correlative liberation of iodine from the dissolved iodide of potassium.

The difficulty experienced in those early days of making out the real nature of ozone—of ascertaining whether it is a form of oxygen or a peroxide of hydrogen—depended mainly on the very small degree to which it was then possible to charge air or oxygen with the ozone to be examined, and on the necessity for the exclusive employment in the investigation of apparatus in which neither metal nor organic matter was present for the ozone to react with. The apparatus had consequently to be constructed entirely of glass, and all the junctions to be made before the blowpipe or by grinding. Now-a-days, by improvements in the methods of conducting the processes of electrisation and electrolysis, it is possible to charge oxygen with ozone in very considerable proportion; while by means of paraffin, a substance on which ozone is without recognisable action, junctions of the glass apparatus employed may be made and unmade with the greatest facility.

III.

Assuming the ozone furnished by the three principal processes for its production to be one and the same substance, it was not until the year 1863 that the absolute freedom of ozone from any proportion of hydrogen was so definitely established as not to allow of any further question. In this year, Soret showed that although ozonised oxygen obtained by electrolysis, after having been desiccated as thoroughly as possible, frequently yielded some water as a product of its decomposition by heat, yet that when certain precautions were taken, and certain sources of error in the production and collection of the electrolytic oxygen were recognised and avoided, a uniformly negative result was obtained, and not a trace of moisture or other compound of hydrogen resulted from the decomposition by heat of the ozone present in the oxygen.

This conclusion of Soret's was confirmatory both of the previous result of Andrews with regard also to electrolytically obtained ozone, and of the yet earlier result of Schönbein himself with regard to the ozone obtained by the slow oxidation of moist phosphorus. For in opposition to the view enunciated first by himself, and in seeming discrepancy with the undoubted fact that for the production of ozone by means of phosphorus the presence of moisture is essential, Schönbein, in 1849, showed by repeated experiment, that when ordinary air in quantities of several hundred litres, ozonised as strongly as possible by its passage over moist phosphorus, was transmitted first through a desiccating tube, then through a tube heated to 400°, so as to effect the destruction of the ozone present, and finally through another desiccating tube to absorb any moisture that might result from the destruction of the ozone, this last desiccating tube did not show, by an increase of weight or other change, any absorption of moisture whatever, notwithstanding the largeness of the absolute quantity of ozone destroyed in the experiment. From this time forth, Schönbein abandoned the notion of hydrogen being a constituent of ozone; and while making a valid distinction between his own view and that of Marignac and De la Rive, admitted with them that the matter of ozone is identical with the matter of oxygen. *These last-named investigators, in their research already referred to (1845), showed* that perfectly dry oxygen, submitted to the influence of electric discharges, experienced an alteration of character, whereby it acquired the property of liberating iodine from moist iodide of potassium,—a result afterwards confirmed by Fremy and Becquerel. But they did not regard this alteration of character as due to the formation in small proportion of a new substance within the mass of oxygen, but rather to the assumption by the mass of oyxgen of a peculiar electric condition. Moreover, the fact of dry oxygen being capable of some modification by the action of electric discharges, coupled with the fact of the inability of the so modified oxygen to act upon iodide of potassium save in the presence of water, was not inconsistent with the notion of this modified oxygen having to unite with water in order to produce a compound identical with the ozone obtained immediately from moist or watery reagents. That the effect of electrical discharges, and more particularly of the silent discharge, on perfectly dry oxygen, is really to convert a small proportion of this oxygen into ozone identical with that furnished by electrolysis, and capable of acting upon certain substances, as mercury and iodine, when in the dry state, and on certain other substances, as iodide of potassium and metallic silver, only when in the moist state, was first put beyond question by Andrews and Tait, in a research next to be considered.

IV.

In the spring of 1860, Dr. Andrews and Professor Tait made a joint communication to the Royal Society on the volumetric relations of ozone. The primary object of this research was to ascertain whether any, and if so what, alteration of volume took place in the conversion of a given quantity of oxygen into ozone. They thus attacked the problem from an entirely new point of view, and, with admirably directed pains and skill, succeeded in making probably the most important contribution hitherto made to an exact knowledge of the nature of the ozone. In their experiments, a quantity of perfectly pure and dry oxygen, contained in a straight glass tube with a pressure-gauge appendix, was ozonised by means of the silent electric discharge passed through the gas for some time. Coincidently with the passage of the silent discharge through it, the quantity of gas contained in the glass tube was observed to undergo a marked contraction in volume. This contraction proceeded at first rapidly, but afterwards more slowly, till it attained a limit which, in one of their experiments, was estimated at one-twelfth the original volume of the gas. And as whenever the gas, contracted in this manner, was examined, it was found to be proportionately ozonic, the general fact was established that the production of ozone from ordinary oxygen is attended with a contraction in volume. The converse result was also obtained. It was found that when oxygen, contracted by the passage of the electric discharge, was exposed for a short time to the temperature of 270°—300°, it was restored to its original volume. And as whenever the gas, re-expanded in this manner, was examined, it was found to be free from ozone, the general fact was established that the conversion of ozone into ordinary oxygen is attended with an expansion in volume. And this alternate contraction of a given quantity of oxygen by exposure to prolonged electrisation, with production of ozone, and re-expansion of the gas to its original volume by exposure to a temporary heat, with destruction of ozone, could be repeated an indefinite number of times. Now the only possible conclusion to be drawn from these experiments would appear to be that, the matter of ozone being identical with the matter of oxygen, ozone is oxygen in a denser form,—that is to say, in the form of a more complex unit. Some years afterwards, this conclusion was confirmed in a very interesting manner by Professor Tyndall, in the case of ozone obtained electrolytically. He found that the absorptivity for radiant heat of electrolytically obtained oxygen, when rich in ozone, was upwards of a hundred times greater than that of ordinary oxygen—a result indicating ozone to have a more complex molecular constitution, and consequently a greater densit-

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ordinary oxygen. Moreover, after this same electrolytically obtained and richly ozonic oxygen had been subjected to the action of heat, so as to have its ozonic character destroyed, it then exhibited merely the absorptivity for heat of ordinary oxygen,—the observed absorptivity not going at all beyond that of ordinary oxygen, as would have been the case if the ozone originally present in the electrolytic gas had been decomposed into ordinary oxygen and aqueous vapour.

Referring to the statement already made, that in Messrs. Andrews and Tait's experiments, the oxygen gas, more or less contracted by the electric discharge, was found to be proportionately ozonic, this point was ascertained in the following way:—A small thin glass bulb, containing a solution of iodide of potassium, was introduced into the oxygen-holding tube, prior to its being filled with the gas; which, after having been more or less contracted by the process of electrisation, was next submitted to the action of the solution, released on the breaking, effected by concussion, of the small bulb wherein it was contained. And on estimating the quantity of iodine set free from the iodide of potassium solution by its reaction with the contracted gas, it was found to be the exact chemical equivalent of a weight of oxygen equal in volume to the amount of contraction which the original gas had experienced during the process of electrisation; so that if in the process of electrisation, there had been 1, 2, or 3 c.c. of contraction, the quantity of iodine liberated was chemically equivalent to the weight of 1, 2, or 3 c.c. of oxygen; whence it results that to ascertain the iodine-titre of the ozonised gas is to learn the contraction of the original gas effected by its electrisation, or the correlative expansion of the electrised gas effected by its exposure to heat. In the case also of electrolytically obtained ozonised oxygen, it was shown firstly by Andrews and Tait, and subsequently by Soret, that the iodine-titre of the gas is the measure of its expansion by heat, consequent on the conversion of its constituent ozone into ordinary oxygen.

(To be continued.)

RESEARCHES ON THE PART WHICH SULPHUROUS ACID PLAYS WHEN EMPLOYED FOR THE SACCHARIFICATION AND SUBSEQUENT ALCOHOLISATION OF GRAIN,

ACCORDING TO A NEW METHOD.

By V. HEMILIAN and N. MELNIKOFF.

DURING the last few years, a process has been introduced in the distilleries of Russia and Southern Germany, Bohemia, and other portions of the Austro-Hungarian Empire, which is considered by practical distillers to increase the yield of alcohol obtainable from grain, including maize, and which consists in the use of a weak solution of sulphurous acid when applied during the diastatic saccharification.

The raw grain and malt, previously ground to a fine powder, are macerated for from five to six hours in a cold solution of sulphurous acid, after which the mixture is heated to from 70° to 75°, and treated as usual. While there is no doubt that this practice is really good, the action of sulphurous acid on the substances capable of yielding alcohol has never been scientifically elucidated; we have made researches relative to this action, and here publish the principal results of our experiments.

In the first place, we have found, by a series of experiments, that sulphurous and other acids, employed in small quantities in practice, have the effect of very perceptibly diminishing the saccharifiant power of diastase, and, as a consequence of the application of the new method of saccharification, the action of a portion of the malt employed is rendered useless; but, on the other hand, our experiments have proved that sulphurous acid, applied in quantities to be hereafter indicated, renders the starch of the meal, when macerated in it for a long time, more fit for conversion into glucose. It is probable that suphurous acid, during the process of maceration, dissolves slowly the gluten and other albumenoid substances which envelope the starch in the meal, and thus the immediate contact of the starch granules with the solution of the diastase is promoted during the saccharification.

The effect produced by the action of the sulphurous acid consists, therefore, in the difference of the two opposite actions, one of which is injurious to alcoholisation, by decreasing the saccharifiant power of malt, while the other favours a more complete interversion of the starch of the substances employed. This difference, which determines the increase in the quantity of glucose, depends directly on the duration of the cold maceration, and on the quantity of sulphurous acid employed. The largest quantity of glucose is obtained by causing the cold maceration to continue for five or six hours with a solution containing from 0·1 to 0·13 per cent of the quantity of malt and meal used.

When the duration of the cold maceration is prolonged, and the quantity of sulphurous acid diminished, the quantity of glucose obtained is increased to its maximum. When the maceration in cold water, without sulphurous acid, is continued for eighteen hours, the result is equal to that obtained by the use of macerating with cold sulphurous acid solution; but maceration in cold water only is sure to bring on acidification and incipient putrefaction, which is not the case when sulphurous acid is present. If, on the other hand, the quantity of sulphurous acid is increased, and the time of cold maceration decreased, the quantity of glucose obtained rapidly decreases, because the injurious influence of the sulphurous acid upon diastase then begins to predominate over its favourable action upon the meal.

The increase in the yield of glucose, under the action of sulphurous acid and the most favourable conditions, is found to vary from 2 to 3 per cent of the weight of the grain employed. No sulphuric acid is formed during the cold maceration alluded to; the sulphurous acid forms, with the macerated materials, combinations from which, by the application of mineral acids, the sulphurous acid is set free without simultaneous precipitation of sulphur, so that no formation of hyposulphites takes place. The colouring matter of malt is, moreover, destroyed by the cold maceration with sulphurous acid; and, since we have found that the combinations formed by sulphurous acid during the cold maceration do not perceptibly injure the saccharifiant property of diastase, we propose the following modification in the application of this method. The meal only, without malt, is macerated in the cold with the solution of sulphurous acid of the strength above mentioned, and then heated to 50°, so as to volatilise any free sulphurous acid. The malt is next added, and the mixture, being all the time well stirred, is heated to from 70° 75°, these temperatures being best suited for saccharification. As regards the action of sulphurous acid upon the process of fermentation, comparative experiments have proved that this acid, in free state, even in so small a quantity as 0·2 per cent of the sugar, very perceptibly hinders the alcoholic fermentation which is rendered very slow, while the combinations formed by the sulphurous acid during the maceration, do not at all effect the ordinary course of the fermentation, which continues regularly until all the glucose is spent. During the fermentation of the wort obtained by the new method, and application of sulphurous acid, sulphuretted hydrogen is evolved in small quantity mixed with carbonic acid, while, in the fermenting liquid, sulphur compounds are formed which it would be very interesting to study more minutely. It is very important, for practical purposes, to know that, in wort fermenting under the conditions just mentioned, almost twice as little free acid is formed than in the fermentation of grain, malt, and meal under the ordinary conditions. The utility of the sulphurous acid process is

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rendered very apparent when it is borne in mind that the free acids alluded to are formed at the expense of alcohol, while, at the same time, by the decrease of acids the nutritive value of the spent wash is rendered greater, and its consumption by cattle improved because it is rendered less injurious to health.—*Moniteur Scientifique.*

NOTE ON THE PURPLE OF CASSIUS.

By H. DEBRAY.

WHEN a solution containing simultaneously protochloride and bichloride of tin, is poured into a very dilute solution of chloride of gold, the result is the formation of a brown-coloured fluid which is turbid when seen by reflected, and purple when seen by transmitted, light; while after a time a coloured precipitate is deposited in the liquid, which is the so-called purple of Cassius, and is—as is well known—the basis of all gold pigments employed in glass and porcelain staining for the purpose of producing rose, red, and violet colours.

The purple of Cassius may also be obtained under other conditions, and its composition varies with its mode of preparation, but is always such that it (the purple) may be represented as consisting of hydrated binoxide of tin and metallic gold in very finely divided state. The colour of this substance is the deeper the more gold it contains, but does not differ from the hues which the precipitation of gold alone can produce, so that Macquer, who first made this observation, viewed the purple of Cassius as a mixture of gold and hydrated binoxide of tin. Proust having observed that the purple dissolves in ammonia while still wet, and that on being triturated with mercury it yields no gold, the mixture hypothesis was generally abandoned, and the purple considered to be a chemical combination. The only rational mode of viewing the composition of this combination was to consider it to be a saline oxide, that is to say, a stannate of protoxide of tin and suboxide of gold, the latter containing a sufficient quantity of oxygen to convert the protoxide of tin into binoxide. This saline oxide might, moreover, be mixed with a variable proportion of stannic hydrate (*hydrate stannique*).

Since Proust's days, there have been many discussions and more researches on the constitution of the purple of Cassius. It would be impossible to give a *resumé* of these labours here; suffice it to say that no decisive arguments or any new view has been published in favour of either of the two hypotheses just alluded to, and which in my opinion are quite erroneous. I consider the purple of Cassius to be a lake of stannic (or metastannic) acid coloured by very minutely divided gold. The colouring matter of this lake has become insoluble in its usual solvent, mercury, just as the fast colours of the dyer resist the action of water in consequence of their union with the fibres of the woven fabrics, or with the mordants. The following results of experiments, and explanation of facts discovered by me will, I hope, completely justify this mode of viewing the purple of Cassius. I boil together a mixture of solutions of bichloride of tin and acetate of soda; the result is that binoxide of tin is precipitated. I next pour into the hot liquid a small quantity of chloride of gold, and then some oxalate of potassa; the result of which is that the gold is immediately reduced, and while only a small quantity of the metal is precipitated on the glass, the bulk of it is precipitated upon the oxide of tin, which thereby assumes the ordinary colour of the purple of Cassius. A perfectly similar colour can be produced with alumina by precipitating gold in a fluid which contains alumina in a state of suspension. For this purpose, I add to a solution of chloride of gold, saturated with acetate of soda, gelatinous alumina, and to the hot mixture I add gradually oxalate of potassa, whereby the gold is reduced. These two lakes having been kept suspended *in* water and shaken up in a closed strong glass vessel for *several hours with mercury*, have not lost their colour.

The ordinary method of preparing the purple of Cassius does not evidently differ from that just alluded to, except that the oxide and the colouring matter are precipitated together, by which means the beauty of the colour is undoubtedly increased, as well as its fastness towards mercury. It now remains to be explained how it is that this lake is soluble in ammonia. We know that oxide of tin is soluble in ammonia when precipitated at the ordinary temperature, so long as the oxide continues wet, and that it ceases to be soluble in ammonia under various conditions, as for instance, an elevation of temperature, and more particularly drying. The purple of Cassius loses its solubility in ammonia under precisely the same conditions, and hence it ought to be observed that the solution of purple of Cassius in ammonia (that solution being always turbid when viewed by reflected light) deposits slowly metallic gold, while the oxide of tin remains almost entirely in solution. This well-known fact is quite natural if the purple is a lake, but it is very difficult to explain if the gold is in the state of oxide, because the action of ammonia on the metallic oxides of the precious metals gives rise to the formation of more or less complex products, but never sets the metal free.

Mercadieu has observed that in the assay of the precious metals when silver which contains a small quantity of tin and of gold is dissolved in nitric acid, a substance is obtained very analogous to the purple of Cassius; and since gold is not oxidised by nitric acid, he inferred that the purple of Cassius contain the gold in the metallic state. Gay-Lussac having resumed these researches came to the same conclusion, but since this purple of Cassius so formed was not soluble in ammonia, it became necessary to demonstrate the identity, or at least the isomerism, of the two purples, Gay-Lussac feeling inclined to admit isomerism between the two substances. It can be proved that no other difference exists between the two purples except that due to the difference of conditions under which the binoxide of tin is formed. The oxide of tin obtained by the oxidation of that metal by the aid of heat is insoluble in ammonia, and the same holds good for the lake which it forms with gold. But if the ternary alloy of silver, gold, and tin is acted upon at a gentle heat, a purple is obtained which is soluble in ammonia, and I have found, by direct experiment, that the oxide of tin obtained under these conditions is soluble in that reagent.—*Comptes Rendus.*

THE CHEMICAL EQUIVALENT OF ETHER.*

By H. F. WALLING, Professor of Civil Engineering in Lafayette College.

SUPPOSING the ether of space to be a gas, and therefore that it must have an atomic weight or chemical equivalent, I have thought that under the dynamic theory of gaseous elasticity this atomic weight could be computed in a simple manner whenever certain data should be sufficiently well determined, and that even now a tolerable approximation may be attained

In the equation

$$WV^2=CT.$$

Let W represent the weight of an atom or molecule of any gas, V the velocity of an acoustic wave in this gas, and T any temperature reckoned from absolute zero in degrees which represent equal accessions of energy to the gaseous atoms or molecules. Then will C be constant, or nearly so, for all gases at temperatures considerably above that of their liquefaction.

To prove this we have first to show that V^2 changes in a constant ratio with T in any gas, W remaining constant.

Now the velocity of an acoustic wave is ascertained by calculating the velocity acquired in falling a distance

* Read before the American Association at Indianapolis

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equal to one-half the length of a homogeneous column of the gas having a sufficient height when vertically placed to produce by its own weight a pressure equal to that maintained in the gas. The velocity thus found is multiplied by a coefficient, constant for all gases and at all temperatures.† Since the height of the balancing column is, according to the law of Gay-Lussac, proportional to the absolute temperature, and since the square of the velocity acquired in falling is in proportion to the height of the fall, V^2 maintains a constant ratio to T, and C is constant so long as W remains unchanged.

Moreover, since the densities of different gases, at common temperatures and pressures are proportional to their atomic weight, the heights of their balancing columns, and therefore V^2 must be *inversely* proportioned to W. Hence the product WV^2 is the same for all gases having a common temperature, and hence C is constant for all gases at all temperatures considerably above liquefaction.

Assuming for hydrogen that W = 1, and taking the velocity of sound in that gas at zero centigrade to be 4164 feet per second, as determined by Dulong, we have

$$(4164)^2 W = 273C,$$

zero centigrade being equal to 273° of absolute temperature. Whence C = 63512.

A luminiferous wave is generally supposed to be similar in its nature to a sound wave. If this be true, the general equation with C as above determined will apply to the ethereal medium.

The velocity of light is, in round numbers, 1,000,000,000 feet per second, which gives—

$$(1{,}000{,}000{,}000)^2 W = 63512T,$$

in which T represents the temperature of the interplanetary spaces. Hopkins places it at 38·5° C., Fourier at −50°, and Pouillet at −142°.‡

The values of W calculated for ether with these values of T are as follows:—

T = −38·5° = 234·5° absolute temperature,
W = 0·000000000014893564.
T = −50° = 223° absolute temperature,
W = 0·000000000014163176.
T = −142° = 131° ab. temp., W = 0·000000000008320072.
Taking the mean of the estimated temperatures,
T = −77° = 196° ab. temp., W = 0·000000000012448352.

Comparing the values with the fraction—

$$\frac{1}{2^{36}} = \frac{1}{68719476736} = 0{\cdot}000000000014551912$$

it appears that the atomic weight of ether is probably equal to that of hydrogen after it has undergone not less than 36 or more than 37 successive halvings.

Perhaps an objection will be made to this conclusion that the transverse vibrations, which constitute light, indicate that their medium is solid rather than fluid, and therefore that the relations between its atomic weight and wave velocity is different from that of gases.

I have advanced the supposition in previous papers that the atoms of bodies, in consequence of their momenta and mutual attraction, fall into a linear arrangement; that the "elemental fibres" thus constituted intersect each other so as to occupy space in its three dimensions, forming the edges of imaginary cubes in gases; that the atoms being *non-impenetrable* traverse freely each line of fibre in both of its directions, tending to preserve equality of distances by mutual attractions, and the accelerations produced by temporary *huddlings*; and that longitudinal vibrations, along the fibre (condensations and rarefactions) in consequence of the mutual actions and reactions of intersecting fibres, are accompanied by transverse vibrations (undulations), which in ether constitute light, the *resultant* impulses being radial for the longitudinal and concentric for the transverse vibrations.

If such a hypothesis be found tenable, it will remove any objection to the above conclusion founded upon a supposed constitutional dissimilarity between ether and ordinary gases.

† This coefficient as found by experiment is $\sqrt{1{\cdot}42}$, and it represents the amount of acceleration which is produced by the disturbance of temperature developed in the condensation and rarefaction of the wave. The cause and amount of this acceleration was first indicated by La Place; $\frac{1{\cdot}42}{1{\cdot}00}$, the square of the above coefficient being the ratio of the amount of heat expended, including the *external work* done when a gas is heated and allowed to expand under a constant pressure, to the amount expended to produce an equal elevation of temperature, when no external work is performed, the *volume* remaining constant. It is now believed that the same coefficient applies to all gases whose powers of absorption and radiation are inconsiderable.

‡ Nichols's Cyc. of Physical Science. Art. Temperature.

ON THE PRESENCE OF DIDYMIUM IN CERTAIN SPECIMENS OF PYROMORPHITE.

By CHARLES HORNER.

IT will be remembered that I drew attention to the fact of the presence of didymium in a specimen of pyromorphite from Cumberland (see CHEMICAL NEWS, vol. xxvi., p. 109, and Professor Church's note thereon, p. 130). Lately, through the courtesy of Professor Maskelyne, I have been enabled to examine other specimens of the above mineral in case 60 at the British Museum, and found that most of the specimens from Loughton Gill, Cumberland, contained this rare element. I likewise detected the absorption lines of didymium in some very elegant specimens of pyromorphite from Wheal Alfred, Cambourne, Cornwall, and in others from the Vale of Towy, Caermarthenshire.

Mortlake, December, 6, 1872.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, December 5th, 1872.

DR. FRANKLAND, F.R.S., &c., President, in the Chair.

WHEN the minutes of the previous meeting had been read and confirmed, Messrs. F. W. Fison and T. A. Ormerod were formally admitted Fellows of the Society.

The donations were then announced, and the names of Messrs. George Washington Arnott, James Scott McGregor, and Cornelius A. Mahony read for the first time; for the third time, Messrs. Kigonari H. Yoshida, Francis H. Hobler, Sydney Lupton, E. W. Prevost, Ph.D., Thomas Williams, T. D. Titmal, Joseph Lainson Wills, A. Percy Smith, Philip Braham, John Hollings Mitchell, M.A., Robert William Jones, and A. Cameron Bruce, M.A. who were balloted for and duly elected.

The first two papers "*On Hypophosphites*," and "*On the Reducing Power of Phosphorus and Hypophosphorous Acid and their Salts*," by C. Rammelsberg, were read by the Secretary. In the first paper the author, after mentioning the labours of Rose and Wurtz on this subject, gives a detailed account of the crystalline form, amount of water of crystallisation, and mode of decomposition by heat of the numerous hypophosphites which he had examined, five of which, namely those of sodium, lithium, thallium, cerium, and uranium, had never before been noticed. The results of his experiments show that the hypophosphites of thallium, calcium, cadmium, and lead have no water of crystallisation; those of sodium, lithium, barium, strontium, manganese, and uranium one molecule; whilst those of magnesium, zinc, nickel, and cobalt have six. They are all decomposed by heat, evolving a mixture of hydrogen and phosphoretted hydrogen, which is sometimes spontaneously inflammable and sometimes not, leaving a residue which in most cases consists of a mixture of pyrophosphate and metaphosphate of the metal; but tl

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residue of the uranyl salt contains phosphide in addition, whilst the nickel and cobalt salts leave a mixture of metaphosphate and phosphide.

In the second paper, mentioned above, the author finds that the ultimate action of phosphorous acid on silver and copper salts is to precipitate the metal whilst hydrogen is simultaneously evolved. Barium hypophosphite with silver salts, and hypophosphorous acid with copper salts, likewise reduce the metal and evolve hydrogen, the acids in both cases being oxidised to phosphoric acid.

Dr. FRANKLAND in asking the members to return their thanks to Professor Rammelsberg for his interesting communication, said that the investigation of these compounds of phosphorus must be welcomed by all chemists. Some important theoretical points presented themselves for discussion, as to the way in which the hydrogen was placed, and the cause of the phosphoretted hydrogen evolved being in some instances non-spontaneously inflammable, and in others spontaneously inflammable, the latter being probably occasioned by the presence of traces of the liquid phosphoretted hydrogen, P_2H_4.

Mr. VERNON HARCOURT said that in studying the action of heat on such substances, although they were pure, well crystallised, and homogeneous, we were experimenting under circumstances of a very varying nature. If it were possible to heat the whole of a substance simultaneously to the same temperature, we should probably obtain only one result, but as it was most likely that the substance had been rapidly heated, every part had not been exposed to the same temperature, so that sometimes spontaneously inflammable phosphoretted hydrogen was obtained and sometimes not. In order to study the circumstances under which these different phenomena occurred the subject would need to be very carefully examined.

Professor WILLIAMSON remarked that one of the great difficulties in the experiments on the action of heat on the substances described by Professor Rammelsberg, was that one portion of the substance would necessarily be heated in the products of decomposition of another, that is some of the molecules would be decomposed whilst others were heated in a current of the products of decomposition. This, however, was not the only difficulty, for, to take a common case, viz., the action of heat on chlorates, here we have most of the molecules giving off oxygen, but others are simultaneously taking up oxygen to form perchlorates. From a dynamical point of view, we should not expect that individual molecules would have different rates of vibration and therefore behave differently, but the fact remained that some molecules did behave differently from the others.

The PRESIDENT said that he inclined to the opinion that there were very few cases of chemical action where but one product was produced, even under the most favourable and uniform circumstances—that of two gases mixed by diffusion and then exposed to the action of light; there was always some variety of action.

The next paper on "*New Analyses of Certain Mineral Arseniates and Phosphates*," by A. H. CHURCH, was then read by the author. It contained numerous and carefully made determinations of the composition of six minerals.

Apatite.—In the pure crystals of apatite, from Murcia in Spain, the author finds nearly 1 per cent more tricalcic phosphate than corresponds to the formula $Ca_5 3PO_4F$, while there is a deficiency of nearly 2 per cent in the calcium fluoride.

Arseniosiderite.—By a series of analyses of a singularly pure specimen of this mineral, the author establishes the formula $5CaO,H_2O,Fe_2O_3,3As_2O_5,+3Fe_2O_3,2H_2O$. It is remarkable that the ferric hydrate, $3Fe_2O_3,2H_2O$, resembles arseniosiderite very closely, it is known as xanthosiderite.

Childrenite.—Numerous analyses have been made of this mineral, the formula—

$$5FeO,2MnO,2H_2O,3P_2O_5+2Al_2H_6O_6+4aq.$$

corresponding well with the analytical results.

Ehlite.—The author gives the analyses of three specimens of this mineral from Cornwall, deducing from them the formula $3CuO,P_2O_5+2CuH_2O_2+aq$. This expression exactly corresponds among the phosphates to that for Cornwallite among the arseniates, the latter mineral having been previously shown by the author to have the formula $3CuO,As_2O_5+2CuH_2O_2+aq$. Professor's Church's conclusions as to this Cornish phosphate of copper were published in abstract in the CHEMICAL NEWS.

Tyrolite.—The author finds this species, like chalcophyllite, which it much resembles, to be strongly hygroscopic. The calcium carbon which it contains is proved to be integral and essential part of the mineral, the formula becoming—

$$\left.\begin{matrix}3CuO\\CaO\end{matrix}\right\}\begin{matrix}P_2O_5\\CO_2\end{matrix}+2CuH_2O_2+2aq.$$

Wavellite.—Some pure samples of this mineral from one of the localities near Cork were examined. It would appear that there are only $11H_2O$ and not $12H_2O$ in this mineral. When dried *in vacuo*, or at 100° C., its formula thus becomes, if we reject the fluorine,—

$$2(Al_2O_3,P_2O_5)+Al_2H_6O_6+8aq.$$

The PRESIDENT thanked Professor Church in the name of the members of the Society for his contributions to our knowledge of these well-known minerals, and also for having supplied constitutional formulæ for some that had hitherto been destitute of them.

The last paper read was "*On the Condition of the Hydrogen Occluded by Palladium as Indicated by the Specific Heat of the Charged Metal*," by W. CHANDLER ROBERTS and C. R. A. WRIGHT, D.Sc. In this paper, which is a continuation of the one read before the Chemical Society on the 7th November, the authors give a detailed account of their experiments, and the methods employed in determining the specific heat of palladium, or of an alloy of palladium and gold, when charged with hydrogen by making it the negative pole in the electrolysis of acidulated water, and also of the uncharged metals. Assuming that a true alloy of the metal and hydrogen is formed, it would be easy, in accordance with Kopp's law, to calculate the specific heat of the occluded hydrogen. Since, however, the authors find that the specific heat of the occluded hydrogen calculated in this manner varies according to the amount of hydrogen present in the charged palladium —being as low as 0·4 when the palladium is fully charged, and as high as 0·9 when it is charged with a small volume of hydrogen—they infer that the palladium does not form an alloy with the occluded hydrogen, neither can it be regarded as a mixtnre of a definite palladium hydride with excess of palladium, as in that case either a constant value would be found, or the variation in the specific heat would be represented by a straight line and not by a curved one. The authors are therefore inclined to believe that in palladium charged with hydrogen each several charge must be regarded as giving rise to a distinct compound, and that palladium and hydrogen are capable of entering into combination in proportions which cannot be expressed by comparing simple multiples of the combining numbers of these elements respectively, that is, by simple formulæ.

The results of the experiments were illustrated by a carefully constructed curve.

The PRESIDENT said that the members would, doubtless, have great pleasure in according their thanks to the authors for their important communication on occluded hydrogen, and hoped that it would lead to an examination of the state in which the hydrogen was in this alloy or mixture. It would seem that it was not a definite compound of hydrogen and palladium, and therefore not in the state which the researches of Professor Graham had led us to suppose, and which had excited so much interest.

Mr. ROBERTS said they were somewhat disappointed that the results of their experiments did not favour the view that it was an alloy of hydrogen and palladium. He might state that the chief reasons why Professor Graham considered the hydrogen to be alloyed with the palladium were the calculated density of the hydrogen in the charged palladium, 0·733, taken in conjunction with its uni-

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tensile strength, and its high electric conductivity. At the present time the relation between the hydrogen and palladium was very obscure, and could only be elucidated by a long series of carefully conducted experiments.

The meeting was then adjourned until Thursday, December 19, when papers will be read on the "*Analysis of Water of the River Mahanuddy*" by E. Nicholson, and "*On the Polymerides of Morphine and their Derivatives*," by E. Ludwig Mayor and C. R. A. Wright.

CORRESPONDENCE.

THE SALT THAT LOST ITS SAVOUR.

To the Editor of the Chemical News.

SIR,—In your "Notes and Queries" S. T. S. asks if the salt spoken of by Our Saviour was the chloride of sodium. The following personal experience may be interesting.

Some years ago I used salt as a manure on some land, a stiff clay, but interspersed with granules of carbonate of lime. Some of the salt was in hardish lumps, into which the small crystals had become concreted, something like a frozen mixture of ice and snow. These lumps were several weeks before they melted; and before they did so, as they lay on the soil, they lost the taste of salt and acquired that of carbonate of soda. I supposed this to be due to the joint action of the soil and atmosphere. I may add that the salt injured rather than benefited the soil, making it stiffer and wetter than it was naturally for several years.

Many years ago I read in the *Journal of the Royal Agricultural Society* an account of the beds of nitrate of soda in Chili. It was stated there that below the nitrate of soda was carbonate of soda, and below that, common salt. The writer supposed that these beds occupied the bottom of a dried-up salt lake, and that, by the action of the soil and air, the salt had been changed first into carbonate and then into nitrate of soda,—I am, &c.,

H. HIGHTON.

Putney, December 2, 1872.

MISCELLANEOUS.

London Drinking Water.—The following is the second of a series of monthly reports intended as a substitute for the return published by the Registrar General. It is interesting as exhibiting the London water supply at flood-time.

	Parts in a Million. (Milligrms. per Litre.) Free Ammonia.	Albumenoid Ammonia.
Kent Water Co. (Deptford Railway Station, 20th Nov.)	0·01	0·02
New River Co. (Cab Rank, Tottenham Court Road, 21st Nov.)	0·01	0·06
East London Co. (Cambridge Heath Gate, 3rd Dec.)	0·01	0·18
Thames Companies :—		
Chelsea Co. (Cab Rank, Horse Guards, 2nd Dec.)	0·02	0·13
West Middlesex Co. (Cab Rank, Portland Road, 3rd Dec.)..	0·00	0·10
Southwark and Vauxhall Co. (Cab Rank, St. George's Road, 4th Dec.)	0·00	0·18
Grand Junction Co. (Cab Rank, Woodstock Street, 4th Dec.)	0·00	0·17
Lambeth Co. (Cab Rank, Palace Road, 2nd Dec.)	0·01	0·16

J. ALFRED WANKLYN.

Food Analyst for Islington.—Dr. C. Meymott Tidy, Joint Lecturer on Chemistry, and Professor of Medical Jurisprudence at the London Hospital, has been elected Medical Officer of Health and Food Analyst for Islington.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, December 2, 1872.

In addition to a large number of original papers and memoirs relating to mathematics, hydraulics, mechanics, astronomy, physical philosophy, meteorology, physiology, and natural history, this number contains the following original papers and essays relating to chemistry:—

Practical Observations Relating to the Laws Deduced from the Boiling-Point Temperatures of Homologous Organic Compounds.—I. Pierre and E. Puchot.—This memoir, elucidated by a large number of tables, refers to the correctness of the view held by scientific chemists as to the existence of a constant difference of the boiling-point of the homologous organic compounds, the formula of composition of which differs C_2H_2. By carefully-conducted experiments, the authors prove that there does not exist a constant variation, and they find that two homologous substances, one of which contains more or less C_2H_2, may exhibit, in the temperature of their boiling-point, differences varying from 10° to 35·5°, that is to say, a digression of 25·5 per cent.

New Combination of Bromine and Ether, Bromurated Ether.—P. Schützenberger.—This compound is formed directly by addition (not substitution, for no bromhydric acid is given off) of bromine to ether, but the preparation, described at length, requires dexterous manipulation and pure materials. The bromurated ether, below 0°, is a solid crystalline compound, $(C_4H_{10}O.Br_2)_2$, it is very deliquescent, although it remains solid even at 22°, its fusion-point. The combination is very unstable, being decomposed by the action of potassa, of zinc, and by a temperature of 100°, whereby bromhydric acid, water, bromide of ethyl, bromal, and a new substance, $C_4H_2Br_2O_2$, are formed, according to the following formulæ:—

(1). $2(C_4H_{10}O.Br_2) = BrH + H_2O + \underbrace{3(C_2H_5Br)}_{\text{Bromide of ethyl.}} + \underbrace{C_7H_2Br_2O}_{\text{Bibromated aldehyde.}}$

(2). $\underbrace{3(C_7H_2Br_2O)}_{\text{Bibromated aldehyde.}} = \underbrace{C_7HBr_3O}_{\text{Bromal.}} + \underbrace{C_4H_2Br_2O_2}_{\text{Tribromated di-aldehyde.}}$

Neutral Soap Free from Caustic Alkali.—M. Mialhe.—After first referring to some well-known technical details of soap-boiling, the author describes the process of treating soap-shavings with carbonic acid, whereby the caustic alkali present in soap is neutralised by being converted into a bicarbonate.

Anti-Fermentation Action of Silicate of Soda.—M. Picot.—This essay contains the detailed account of the results of a series of experiments, from which the conclusion is drawn that silicate of soda has the effect of arresting putrid fermentation, even when applied in small quantity. The author also states that the silicate of soda exerts marked physiological and therapeutical action.

Substance Extracted from the Fouh-ling, Pachyma pinctorum.—P. Champion.—The cryptogamic plant just named is found in China, and is used by the natives for the cure of certain forms of syphylitic disease. From this drug, the author, who has travelled through China, has obtained a substance, which he terms pachymose, insoluble in water and in ammoniacal copper solution, soluble in potassa, and then forming, with lime and lead salts, insoluble compounds. When treated with boiling dilute hydrochloric acid, the substance reduces the cupro-potassic liquor, while, with nitro-sulphuric acid, pachymose forms a gun-cotton-like substance. The formula of pachymose is $C_{20}H_{32}O_{32}$.

New Vanadiferous Silico-Aluminate of Manganese found at Salm-Chateau, Belgium.—F. Pisani.—The mineralogical description of this mineral is given at length. The sp. gr. of the substance is 3·577; it fuses readily in the blowpipe-flame, forming a black-coloured enamel. Its percentical composition is—Silica, 28·7; alumina, 28·36; peroxide of iron, 2·94; protoxide of manganese, 26·40; lime, 4·30; magnesia, 4·32; oxide of copper, 1·30; vanadic acid, 1·80; loss by ignition, 0·98; total, 99·10. The composition of this mi— which is to be named Dewalquite, in honour of the eminent Be

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mineralogist, Dr. Dewalque, resembles that of masonite, by supposing the iron therein contained to be replaced by manganese.

Le Moniteur Scientifique Quesneville, No. 372, December, 1872.

This number contains the following original memoirs relating to chemistry and collateral subjects:—

Platinum Coinage.—A. Jouglet.—In the introduction to this paper, the author discusses the question whether aluminium might be used as a substitute for bronze or copper coinage. His opinion is that the metal is not a suitable material for this purpose; but if there are invented cheaper methods for the production of aluminium, some of its alloys might be suitably used for coinage. Next, we have the enumeration of the properties of metals in general, so as to render them suitable for coinage. These properties, partly inherent to the metal itself, partly due to its intrinsic value (comparative scarcity), are all possessed in a high degree by platinum, which has been in use as a coin in Russia, but was demonetised by the imperial ukase of June 22, 1845, the reason being that at and before that period the proper methods of working and refining platinum were not well understood. In this respect, however, the researches of Drs. H. Sainte-Claire Deville and Debray, and Messrs. Johnson and Matthey, have made such changes, that there would now be no difficulty in the working of platinum into coins, and, unlike gold and silver, it would be proof against forgery, on account of its high specific gravity. So far back as 1799, experiments were made at the French Mint, at Paris, for the purpose of converting platinum into coins, and Duvivier produced at that period some beautiful specimens of platinum medals. This metal is still largely used for the same purpose in France. The author enters into exhaustive details on the alloys of platinum which might be used as material for coinage, and also gives some statistics on the annual production of platinum in different countries, observing that Dr. Pettenkofer's researches prove that platinum is more generally dispersed than is commonly believed.

Estimation of the Total Quantity of Phosphoric Acid present in a Soil.—E. Grandeau.—The author first thoroughly dries a fair average sample of the soil, and next passes it through a fine sieve, thus eliminating pebbles. 100 grms. of the powder are then taken, and acted upon by pure nitric acid, aided by heat kept up for several hours. The acid solution is decanted, or, if necessary, filtered, and the insoluble residue well washed with distilled water, and the filtrate made up to 500 c.c. Into 100 c.c. thereof an excess of a solution of molybdate of ammonia is poured, and the precipitate of phospho-molybdate collected on a filter, well washed, and next dissolved in strong ammonia. The solution thus obtained, which should be clear and colourless, is used for estimating the phosphoric acid in ammonio-magnesian phosphate. Generally, the author makes a second estimation with another 100 c.c. of the original fluid, and finds that the difference in the two assays does not exceed 0·0005 grm. of phosphoric acid.

Although not belonging to chemistry, we call attention to the following essay:—

Transmission of Cholera by Ships, and on the Organisation of Quarantine.—Dr. M. Pettenkofer.

Bibliography.—Under this heading, we quote the title of the following work:—"Traité des Dérivés de la Houille Applicables à la Production des Matières Colourantes," par MM. Girard et G. de Laire; 1 vol., grand 8vo., de 650 pp., avec 12 planches. G. Masson, Paris; price 16 francs. This important work is divided into the following chapters:—Formation of tar; chlorated derivatives of the hydrocarbons; sulpho-derivatives of the aromatic carburets (*carbures aromatiques*); nitrated derivatives of the aromatic carburets; the coal-tar alkaloids; secondary and tertiary monamines; aromatic diamines; phenolen-diamine and isomers thereof; triamines; industrial applications; industrial manufacture of the coal-tar colours. The plates of this work, exhibiting apparatus and machinery, are drawn and engraved to scale.

Les Mondes, December 5, 1872.

Reorganisation of the Observatories in France.—By a decree of the President of the Republic, a committee of astronomers, mathematicians, and other *savants* has been appointed for the purpose of preparing a Bill to be presented to the Legislative Assembly, with the view of re-organising the existing observatories.

Oxyhydric Illumination.—Rev. Abbé Moigno.—The author reviews, in this paper, the official Report of F. Le Blanc, already briefly referred to in our columns (see Chemical News, vol. xxvi., p. 625), and points out that many of the conclusions arrived at by that gentleman are contradicted by the practical experience obtained at Brussels, Vienna, New York, and other large cities, and that the researches of Dr. Schilling, one of the most eminent scientific managers of gas-works, are also completely at variance with the views of Le Blanc.

November Meteors.—M. André and the Rev. Father Dutirou, S.J.—The authors communicate, from different localities of France (viz., the former from Crépol, the latter from Montauban), that during the night of November 27th last there was witnessed what might almost be termed complete showers of meteors. The weather was calm, sky clear, and the temperature moderately high for the season.

White Gunpowder.—L'Abbé Fortin.—It appears that, some three years back, the author invented a compound (the constituents are not mentioned) which, according to experiments made by competent artillerists and scientific men, possesses advantages over ordinary *gunpowder, gun-cotton*, prussiate powder, picrate of potassa powder, &c., in its mode of preparation, its freedom from danger by storage, as well as its not exploding by concussion, and the cheapness of its constituent materials, while its balistic force is five times greater than that of the best ordinary gunpowder. The author also states that he can alter the mixture to any desired degree of strength and inflammability.

Thermoscopic Barometer.—A. Guiot.—The exhaustive description, elucidated by algebraical formulæ, of an ingeniously-contrived instrument, invented by the author, who received for it the silver medal of the Société d'Encouragement pour l'Industrie Nationale, and also a sum of money. It appears that the instrument has been found to give really correct indications, but hitherto it has not been sufficiently noticed out of Paris, where it is sold for 12 francs. The excellent editor of *Les Mondes* mentions incidentally that it has been tried with success in coal-pits as an indicator of the approach of fire-damp explosions, due to decrease of atmospheric pressure.

Journal für Praktische Chemie, Nos. 14 and 15 (double number), 1872.

Some Derivatives of Mucic Acid.—M. Kœttnitz.—The end of this essay; this portion contains the following sections:—Behaviour of mucate of aniline when submitted to dry distillation; phenyl-pyrrol—

$$\left.\begin{matrix}C_4H_4\\C_4H_2\end{matrix}\right\}N;$$

phenyl-pyrrol-mercuro-chloride—

$$2\left(\left.\begin{matrix}C_4H_4\\C_4H_2\end{matrix}\right\}N\right)HgCl_2;$$

mucate of toluidine, $C_6H_{10}O_8(C_7H_9N)_2$; mucate of toluidine—

$$\left.\begin{matrix}C_7H_7H\\C_6H_8O_6\\C_7H_7H\end{matrix}\right\}N_2;$$

behaviour of mucate of toluidine when submitted to dry distillation.

Preparation and Properties of Protochloride of Gold (Gold-chlorür).—G. Leuchs.—After briefly referring to the modes of preparation and description of properties of this compound, as quoted in various works treating on chemistry, the author records at length the results of his experience in its preparation. It is best obtained by gently heating the perchloride of gold to from 180° to 200°, care being taken to stir the saline mass, which constantly evolves chlorine. The pure protochloride exhibits a yellow colour; this compound is decomposed by water and moist air, the result being the formation of metallic gold and perchloride of gold.

Detection of Water in Essential Oils.—G. Leuchs.—When, to the oils mentioned, a large quantity of petroleum ether (benzoline) is added, the water, if any is present, becomes apparent in the shape of drops.

Fortuitous Formation of Rosolate of Lime.—G. Leuchs.—On pulling down a roof covered with tarred felt, it was found that the layer of lime placed below it had in some parts become converted into rosolate of lime.

Products of the Action of Sodium upon a Mixture of Phosgen Ether and Iodide of Ethyl.—A. Geuther.—Notwithstanding the intrinsic value of this essay, its contents are not suited for abstraction, an observation also applying to the following memoir:—

Molecular and Usual Colours of the Metals, more particularly Gold, and on the Blue-Coloured Combination of Sulphur and Sulphuric Acid.—W. Stein.

Immediate Constituents of Bone-Ash.—Dr. C. Aeby.—This paper treats on a peculiar decomposition which the inorganic matter of bones undergo while being converted into bone-ash, and which is due to the loss of water of crystallisation of the phosphate of lime, and the action of the lime rendered caustic (from carbonate) upon the orthophosphate of lime.

Researches on Green Stones.—T. Petersen.—This mineralogico-chemical monograph is divided into the following sections:—Introduction and general review; the felspar theory; oligoclase from the diorite at Hof; oligoclase from the gneiss at Aschaffenburg; oligoclase from diabase; on the main constituents of massive rocks; felspar, augite, and hornblende; chlorite; magnetic and titanic iron; apatite; formation of serpentine; green stones as the matrix of many useful minerals and ores; method of chemical investigation; the diabases; general characteristics; fine-grained diabase from the Oderbach road, near Weilburg (Nassau-Prussia); coarse-grained diabase from the Lahn tunnel, a tunnel constructed for widening and canalising the river Lahn, at Weilburg; porphyroide diabase from Grävenek, near Weilburg; coarse-grained diabase from Tringenstein. This monograph, which is to be continued, is elucidated by a large number of results of analysis and complex formulæ. The rocks here alluded to also occur largely in some parts of Scotland, and are excellent as building-stone. Taymouth Castle is built of green stone, *chloritschiefer*.

Gazzetta Chimica Italiana, No. 7, 1872.

New Species of Calculi Urinarii from Cattle—Lithurate of Magnesia.—Dr. G. Roster.—The author relates at length under what conditions these urinary stones were emitted by the cattle, and describes the physical appearance, size, and weight of these stones, which he found to consist of lithurate of magnesia, $C_{20}H_{20}N_8MgO_{15}$. The lithuric acid is a snow-white crystalline substance, soluble in water and in alcohol; fusion-point, 204·5°; the small quantity of the acid obtained did not admit of establishing its chemical formula.

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certainty, but it would appear that any of the following formulæ apply to this body:—$C_{29}H_{28}N_2O_{17}$; $C_{30}H_{28}N_2O_{16}$; $C_{15}H_{19}NO_9$.

Composition of Two Different Varieties of Sorghum Seeds.—Prof. A. Cossa.—The author has investigated the seeds of the sugar-yielding Sorghum and of the variety which is not sweet; the average weight of the former seed is 0·243 grm., that of the latter 0·284 grm. The composition of the sweet Sorghum seed, in 100 parts, is—Water, 14·19; organic matter, 82·84; ash, 2·97. Nitrogen, in 100 parts, 1·571; fatty matter, 3·32. The seed which is not sweet contains, in 100 parts—Water, 13·21; organic matter, 84·84; ash, 1·95. Nitrogen, 1·484; fatty matter, 3·13. Husks of the sweet Sorghum seed contain, in 100 parts—Water, 12·94; organic matter, 81·87; ash, 5·19, of which 58·9 per cent is silica. The husks of that which is not sweet contain, in 100 parts—Water, 12·08; organic matter, 83·12; ash, 4·80, of which 67·94 per cent is silica.

Preparation of Caustic Potassa and Caustic Soda.—E. Pollacci.—The author discusses Dr. Wöhler's method (the reaction of copper at red heat upon the nitrates of the alkalies), and next a method invented by him of heating an intimate mixture of 2 to 3 parts of iron-filings with 1 part of nitrate of potassa, which mixture is heated to redness in an iron retort or crucible; the reaction which takes place is exhibited by the following formula:—

$$6KNO_3+10Fe=3K_2O+5Fe_2O_3+6N.$$

Means of Ascertaining the Nature of the Dyes Applied to Woven Fabrics.—L. Gabba.—An essay of intrinsic value, but not suited for abstraction.

Chemical Composition of the Ash of the Leaves and of the Fruit of Lemons.—Prof. A. Cossa.—This lengthy essay contains, in the shape of a large number of tables, the results of a series of analyses of the ash of the leaves, fruit, and seeds of various kinds of lemons, and also of the soil on which the trees producing the same are grown; the contents of this essay are, however, mainly of local interest; these observations equally bear upon the following memoir:—

Chemical Researches on the Ripening of Grapes.—Prof. A. Cossa.

Annales de Chimie et de Physique, December, 1872.

This number contains the following original papers and memoirs:—

Researches on Nitro-Toluen.—Dr. Rosenthiel.—This exhaustive monograph is divided into the following sections:—Introduction, containing a review of the labours of several *savants* on this subject; immediate analysis of nitro-toluen; origin of the isomerism of the two nitro-toluens; is toluen a mixture of two isomeric carburets *(carbures)* on the simultaneous formation of the isomeric nitro-toluens in definite proportion? comparative study of the isomeric nitro-toluens; nitro-toluen-α (para-nitro-toluen of Beilstein and Kuhlberg; binitro-toluen-α (meta-para-binitro-toluen of Beilstein and Kuhlberg; nitro-toluen-β (meta-nitro-toluen of Beilstein and Kuhlberg).

Propagation of the Instantaneous Current of the Leyden Jar.—C. M. Guillemin.—Illustrated with woodcuts.

Light Emitted by Phosphorescent Uranium Compounds.—E. Becquerel.—This essay is the enlarged paper read by the author in the Academy of Sciences (see CHEMICAL NEWS, vol. xxvi., p. 82).

La Revue Scientifique de la France et de l'Etranger, November 30, 1872.

This number contains the following original memoir collaterally relating to chemistry:—

Evolution of Organic Matter by the Processes of Living Organisms.—Dr. Wurtz.—The first portion of a series of papers on chemical biology.

December 7, 1872.

This number contains, in addition to a letter from the Minister of Public Instruction concerning the opening of the New Medical Faculty at Nancy, and the *éloge historique* on Isidore Geoffroy Saint-Hilaire, by Dr. J. Dumas, the following original essays relating to chemistry:—

The Hydrates of the Monobasic Fatty Acids.—E. Grimaux.—Not suited for abstraction.

Chemical Studies on Vegetation.—J. Raulin.—The results of the author's researches on the growth and development of the *Aspergillus niger*, and on the various conditions which promote, retard, or entirely prevent the formation of this microscopic cryptogamic plant.

Some curious statistics concerning the average duration of life of the Academicians are recorded in a paper written by M. Potiquet.

Bulletin de la Société Chimique de Paris, November 15, 1872.

This number contains no original papers.

Bulletin de la Societé d'Encouragement pour l'Industrie Nationale, No. 240, December, 1872.

This number contains the following original paper relating to physical science:—

Report on, and Theory of, Bourbouse Balance Galvanometers.—M. De Lissajous.—This essay is illustrated by engravings, and contains the minute description of an ingeniously-contrived physical instrument of great value.

This number contains the exhaustive programme of the prize essays proposed to be answered by this society for the years 1873 to 1878 inclusive.

PATENTS.

Communicated by Messrs. VAUGHAN and SON, Patent Agents, 54, Chancery Lane, London, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

2672. E. Withy and W. Gibson, West Hartlepool, Durham, "Improvements in puddling furnaces, and in preparing iron for being operated upon therein and charging, such improvements in preparing for and charging being applicable in connection with cupolas, vibratory and refinery furnaces."—Petition recorded September 9, 1872.

3382. E. A. Cowper, Great George Street, Westminster, "Improvements in separating the fibres of materials producing paper pulp, and apparatus therefor."—Petition recorded November 13, 1872.

3412. G. Alsing, Preston, Lancashire, "Certain improvements in the treatment of night-soil and other refuse matter."—Petition recorded November 15, 1872.

3421. T. Bagley, Birmingham, "A new or improved varnish."—Petition recorded November 16, 1872.

3445. R. Hornby, Marchmont Street, Middlesex, "Improvements in treating fatty materials in combination with various kinds of pitch, alkalies, and oil, also in the treatment of animal, vegetable, and mineral oils for lubricating purposes."

3446. C. D. J. Seitz, Edinburgh, N.B., "An improved apparatus for, and method of, treating wood and other similar substances for the manufacture of half-stuff and paper."

3451. C. L. Siecimoski, Balham, Surrey, "Improvements in the preparation of photographic tracing-paper, and in the fluid employed in connection with the same."—Petitions recorded November 19, 1872.

3470. W. G. Brunner, Glasgow, N.B., "An improved process for annealing and cleansing the surfaces of iron or other metals."—A communication from Messrs. Schulz and Heyl, Berlin.—Petition recorded November 20, 1872.

INVENTION PROTECTED FOR SIX MONTHS BY THE DEPOSIT OF A COMPLETE SPECIFICATION.

3502. T. A. Howland and C. G. McKnight, M.D., Providence, Rhode Island, U.S.A., "Improvements in the manufacture of gas, and in apparatus therefor."—Petition recorded November 22, 1872.

NOTICES TO PROCEED.

2137. J. Dale, Manchester, "Improvements in the manufacture of oxalates of soda and potash."—Petition recorded July 17, 1872.

2262. T. R. Crampton, Great George Street, Westminster, "Improvements in the manufacture of gas and fuel, and in apparatus to be used for this purpose."—Petition recorded July 29, 1872.

2276. W. B. G. Bennett, Nichols Square, Hackney Road, and J. C. Watt, Lancaster Road, Notting Hill, Middlesex, "Improvements in the preparation of asphalte, and in the application thereof to the construction of roads and footpaths and other purposes."

2286. A. Browne, Gracechurch Street, London, "Improvements and modifications in the treatment of phosphate in general, and in the production and purification of phosphoric acid and its combinations."—A communication from H. Storck, E. Hentsch, A. Hentsch, A. Lutscher, and F. Grininger, Paris, France.—Petitions recorded July 30, 1872.

2476. A. Deiss, Plaistow, Essex, "A new or improved process of percolation, for the purpose of extracting fatty, resinous, and similar matters."—Petition recorded August 20, 1872.

3163. A. Alison, Bayswater, Middlesex, "Improved means of preserving and curing raw meat, in packing the same, and in apparatus employed therewith."—Petition recorded October 25, 1872.

3192. E. P. H. Vaughan, F.C.S., Chancery Lane, Middlesex, "Improvements in the mode of, and apparatus for, generating gas for lighting and heating purposes."—A communication from E. A. Dubois, Paris.—Petition recorded October 28, 1872.

3273. J. B. Spence, Manchester, "Improvements in obtaining anthracene, and in apparatus connected therewith."—A communication from J. C. F. Cheever, New York, U.S.A.—Petition recorded November 4, 1872.

3292. E. J. W. Parnacott, Leeds, "Improvements in artificial fuel, part of which improvements having reference to the means or apparatus employed in the manufacture of the same."—Petition recorded November 6, 1872.

3309. H. Deacon, Widnes, Lancashire, "Improvements in the manufacture of bleaching-liquor."—Petition recorded November 7, 1872.

PATENTS SEALED.

1616. J. H. Dennis, Liverpool, "Improvements in the treatment of copper precipitate and in the utilisation of impurities contained therein."—Dated May 28, 1872.

1634. L. G. Lysons, Gloucester, "Improvements in the manufacture or composition of paints or substances for covering or coating various surfaces."—Dated May 30, 1872.

1690. W. Riddell, Bishopsgate Street, London, "Improvements in the manufacture of paper pulp from vegetable fibres and in apparatus therefor, which apparatus is also designed to be employed in making chloride of lime for bleaching pulp, and in other similar processes."—Dated June 4, 1872.

2506. E. A. Cook, Viewville House, Midlothian, N.B., "Improvements in treating animal charcoal."—Dated August 23, 1872.

2845. F. Walton, Staines, Middlesex, "Improvements in oxidising oil, and in machinery to be employed for that purpose."—Dated September 26, 1872

2950. T. Greener, Darlington, and W. Ellis, Gateshead, Durham, "Improvements in the manufacture of iron, and in the production of

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'fetling' for improving the quality and yield of iron in the process of reduction."—Dated October 7, 1872.

2964. H. Larkin, Theydon Gernon, Essex, A. Leighton, Liverpool, and W. White, Hampstead, Middlesex, "Improvements in the production of iron and steel."—Dated October 8, 1872.

FOREIGN PATENTS.

BELGIUM.

31372. H. D. Poizot and A. Lagrelle, "Double extraction of beet-juice."

31374. L. and J. Jacobi, "An alloy which is proof against atmospheric action."

31391. J. B. Wattiaux, "New economical fuel."

31393. B. Todd, "Improvements in the treatment of gases and fumes."

31397. E. A. Dubois, "Improvements in the manufacture of lighting-gas, and in apparatus belonging thereto."

31400. F. Ransome, "Obtaining artificial stone."

31403. J. Palliser, V. Grumel, and A. Klopsk, "Decolouring and bleaching textile substances."

31407. C. de Sainte-Marie, "Preparing skins."

31408. D. Urquhart, "Improvements in preserving animal and vegetable substances."

UNITED STATES OF AMERICA.

132154. R. Guenther, "Washing compound."

132204. E. Fabra, "Medical compound for the cure of cholera in hogs, &c."

132233. S. M. Barnes, "Medical compound or anti-dyspeptic bitters."

132242. C. G. Bruce and M. J. Stein, "Process and apparatus for rendering and drying animal matter."

132243. C. G. Bruce and M. J. Stein, "Process and apparatus for treating and drying animal matter."

132264. H. H. Eames and C. J. Eames, "Treating ammoniacal liquor of gas-works, &c."

132265. H. H. Eames and C. J. Eames, "Manufacture of illuminating gas from hydrocarbons."

132266. H. H. Eames and C. J. Eames, "Vaporising hydrocarbons for heating, &c."

132269. W. Farris, "Tanning compound."

132272. F. G. Ford, "Preserving tomatoes."

132275. R. A. Gettins, "Medical compound."

132296. H. Lerner and E. C. Harpold, "Apparatus for the manufacture of bromine."

132324. L. H. Rogers, "Carbonised paper."

132331. L. Stevens, "Furnace for treating ores."

MEETINGS FOR THE WEEK.

Monday, Dec. 16th.—Medical, 8.
—— Society of Arts, 8. Dr. C. Meymott Tidy. Cantor Lectures.
Tuesday, 17th.—London Institution, 4.
—— Civil Engineers, 8. Anniversary.
—— Anthropological, 8.
Wednesday, 18th.—Society of Arts, 8.
—— Geological, 8.
Thursday, 19th.—Zoological, 4.
—— Royal, 8·30.
—— Chemical, 8. E. Ludwig Mayor and C. R. A. Wright, "On the Polymerides of Morphine and their Derivatives." E. Nicholson, on "Analysis of Water of River Mahanuddy." Dr. H. E. Armstrong, "Communications from the Laboratory of the London Institution." J. L. Davies, "On the Formation of Crystallised Copper Sulphide, &c."
—— Philosophical Club, 6.

TO CORRESPONDENTS.

*** Vol. XXV. of the Chemical News, containing a copious index, is now ready, price 11s. 4d., by post, 12s., hansomely bound in cloth, gold lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxvi. commenced on July 5th, and will be complete in twenty-six numbers. Reading Cases, price 1s. 6d. each, post free, may also be obtained at the Office.

W. Pakeman.—(1) Gentele's "Lehrbuch der Farbenfabrikation.' (2) For practical purposes it is insoluble.

A Reader.—You will find the information in Brande's "Dictionary of Science, Literature, and Art," vol. iii. p. 313. Rottenstone is a peculiar kind of tripoli; you will find further information in Dana's "Mineralogy," p. 199. Both works may be consulted at the Library of the Commissioners of Patents.

Chemical Technology, or Chemistry in its Applications to the Arts and Manufactures. By Thomas Richardson and Henry Watts. Second Edition, illustrated with numerous Wood Engravings.

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The Session 1872-1873 will commence on the 1st of October, when—

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The CLASSES will meet as usual.

The CHEMICAL and TOXICOLOGICAL CLASS on Monday and Thursday evenings at 8 p.m., commencing October 1st.

The LATIN CLASS on Tuesdays and Fridays at 8 p.m., commencing October 2nd.

The MATERIA MEDICA and BOTANICAL CLASS, every Wednesday and Saturday at 8 p.m., commencing October 3rd.

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THE CHEMICAL NEWS.

VOL. XXVI. No. 682.

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ON SUPERPHOSPHATES—THEIR ADULTERATIONS AND VALUATION.

By J. EMERSON REYNOLDS, M.R.C.P.,
Professor of Analytical Chemistry to the Royal Dublin Society,
Keeper of the Museum, &c.,

HOWEVER much we may lament the existence of fraudulent dealing on moral grounds, it appears to me a study of high interest to follow this "trail of the serpent" amongst the things around us, to measure its effect upon the general welfare, and to devise means for its detection and suppression. In order to pursue such an inquiry with advantage, we must select a particular class of fraud; and the class to which I invite your attention this evening is that so frequently the subject of investigation by the analytical chemist—viz., the adulteration of articles of commerce. But I may further restrict the few remarks I have to make to a special order of adulteration which materially affects the agricultural community. The frauds to which I refer are those connected with artificial manures; but more particularly with the very important group of fertilisers included under the term "superphosphates."

We have had the opportunity of watching, for many years past, the steady development of a great trade in artificial manures, and the corresponding outcrop of devices by which dishonest traders have imposed on the farmer—with the result of diminishing his produce, and thus indirectly affecting the community at large.

To the agriculturist as to the manufacturer, the value of a superphosphate is directly proportional to the amount of soluble phosphate, insoluble phosphate, alkaline salt, and ammonia, either ready-formed or latent, that it contains. A very few seasons since, it was by no means uncommon to meet with superphosphate sold at a good price, and containing *no* soluble phosphate, and but a small proportion of other valuable substances—clay, road-stuff, gypsum, or waste products of various kinds from chemical works being used up in preparing the very feeble fertiliser. The same materials, of little value, were still more frequently used for diluting the genuine manure, and this practice is far from being uncommon at present.

I need not stop to consider in any detail the effect of this dishonest dealing on the farmer—his wasted means, unrequited labour, and consequent disappointment. To do more than refer to these misfortunes, and to the consequent national loss, would be to repeat an oft told tale.

The adulterators of superphosphate, bold though they were at first, soon received a check, for agricultural societies employed chemists in the detection of the frauds, with the result of obliging the greater cheats either to rest satisfied with the profits derivable from small adulterations, or to transfer their attentions to guanos or other substances that could be rather more safely tampered with.

Speaking now from my experience as chemist to this Society, I am justified in stating that gross adulterations of superphosphate are now rarely practised—probably not because the dishonest dealer has lost the desire for large profits, but for the sufficient reason that the risk of detection is now too great. He has, therefore, fallen back upon the more subtle plan of mixing with a manure a quantity of some nearly worthless substance that it already contains as a natural constituent. The addition of gypsum to a superphosphate is an adulteration of this kind, for all these manures contain gypsum as a necessary product of the action of oil of vitriol on phosphate of lime, whether the latter is derived from bones, coprolites, or other similar mineral phosphates. When this addition of extraneous gypsum falls within certain limits, it is difficult to prove the adulteration, as manures of the same kind, and honestly prepared, are known to vary somewhat in composition. Now, under these circumstances it will be asked, What control have we over this more refined kind of adulteration? The answer to this ought to be, that a complete system of chemical valuation is employed by means of which any sensible reduction from a common standard is at once detected. But such an answer cannot as yet be truly given. Manures of the class referred to certainly have money values attached to them after analysis made on behalf of the purchaser or the vendor; but a very few examples will suffice to show how little importance is to be attached to such estimates. Thus, we find a manure selling at £6 per ton valued at £8 15s.; another, whose selling price is £6 5s., valued at £9 8s.; others, sold at £6 10s., £6 6s., and £7, appraised by one chemist at £7, £8, and £8 10s., respectively, and by another at £6 18s., £7, and £7 2s., though the two sets of analyses fairly agreed and were made about the same time. These discrepancies are accounted for to a considerable extent by supposing that one chemist attaches much more importance to certain constituents than another does; one values in the interest of the vendor, the other in that of the purchaser, and all the estimates are wide of the truth. Valuation of this kind, however, is probably useful for purposes of comparison when a particular set of samples are under examination; but, for general use, the system is simply misleading, and unable, in its present guise, to afford the information we require in dealing with doubtful cases. Hence, about three years ago, I ceased to assign money values to manures, unless where specially requested to do so on receiving a sample for analysis. I understand that Dr. Vöelcker, the distinguished chemist to the Royal Agricultural Society of England, now declines to attach a money value to a sample of manure under any circumstances.

Nevertheless, a satisfactory system of valuation ought to be constructed, as it is capable of rendering great service. I venture to think that no insuperable difficulties lie in the way, and my chief object is to lay before you the details of a plan for estimating relative values of superphosphates which appears to be fair alike to vendor and purchaser. If I succeed in proving to you, in the first place, that we may precisely fix the relative commercial values of the constituents of a superphosphate, and secondly, that we can take a standard to which reference can be made, it will be easy to complete the work and to show how the data may be utilised.

In dealing with the first branch of this question, it is well to explain at the outset the method of valuation at present employed. A certain money value per ton is assigned to each important constituent of a manure, thus: Ammonia, at £95 per ton; soluble phosphate, £30; insoluble phosphate, £11; alkaline salts, £3; organic matter, £1; gypsum, £1. A sample is analysed, and the percentage statement is held to indicate the composition of 100 tons. The number of tons of each body present is then multiplied by its price per ton, the various amounts then added together, and the estimated value of 100 tons obtained.

Having indicated the system at present in use, we now have to fix the relative values of the important constituents, by consulting dealers in the several raw materials as to their cost, and manufacturers of manure as to the expense attending the necessary treatment, excluding charges which do not affect the *relative* values. I have to acknowledge here the promptitude and courtesy with which my inquiries have almost invariably been met by many merchants, agents, and manufacturers. With-

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out giving details of outlay, with which I have been kindly furnished in confidence from several quarters, I may now state the table of equivalent numbers that I have been thus enabled to construct, and these represent the mean of the several values at the present time. We may eliminate the organic matter that appears in an analysis from our list, since I give the equivalent of its latent ammonia, and gypsum, also because the equivalent of biphosphate includes that of the corresponding sulphuric acid of the gypsum. The table is therefore limited to the following six bodies, and these are referred to ammonia as unity :—

Ammonia, ready formed	1·0
Ammonia, latent	2·2
Biphosphate	4·0
Bone phosphate	8·0
Mineral phosphate	13·0
*Alkaline salts	22·5

This table somewhat resembles that of equivalents of the elements used in chemistry ; that is to say, the numbers are strictly proportional to one another, and indicate the replacing values of the different bodies to the manufacturer.

The table also fairly represents the average relative values of the several substances to the farmer. Now, though the *average* agricultural values are not subject to fluctuation, the numbers in the above table require slight corrections to be applied to them from time to time, owing to variations in the *relative* cost of materials. Where any change of the kind is necessary, the correction should be applied prior to the commencement of each season, in order that all manures sold during a particular period should be fairly judged in the same way.

We have therefore substituted for money values a series of proportional numbers that can be used with great advantage, and have thus made the first step toward the solution of the proposed problem. As an example of the mode of using the figures, I may give the following analysis of a fair mineral superphosphate offered for sale at £6 per ton :—

100 parts contained—

Water	12·85	
*Organic and volatile matter	22·65	
Biphosphate	16·99 ÷ 4·0	= 424·2
Neutral phosphate (mineral)	12·25 ÷ 13·0	= 94·2
Alkaline salts	1·50 ÷ 22·5	= 6·6
Sulphate of lime	29·06	
Sand, &c.	4·70	
	100·00	
*Ammonia	0·40 ÷ 1·0	= 40·0
		565·0

In the above analysis, not made by me, the ammonia is not stated to be ready formed, nor is it shown to be latent. Under these circumstances, I consider it fair to the manufacturers to assume that it is immediately available, though it is highly improbable that all the nitrogen exists in the manure as ammonia. The percentages of the four valuable constituents have been divided by the corresponding equivalent numbers, and in the products the decimal points shifted two places to the right, in order to get convenient terms. The numbers have then been added together, and the product I call 565° on the R. D. S. scale of relative value. Instead of shifting the decimal points in the products, we may obviously do away with the decimal points in the analytical statement, and take the numbers given to represent parts in 10,000.

I now give a number of analyses of mineral and bone superphosphate made by different chemists. The samples are numbered, and the manufacturers' names suppressed, for obvious reasons. The *agents'* price to the farmer is given in each case, and the degree of the manure marked on the plan just described.

SUPERPHOSPHATES.

	Mineral.					Bone.					
	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
Selling price per ton	£6	£6 10s.	£6 10s.	£6 10s.	£6 10s.	£8	£8	£8	£6 15s.	£8	£8
Degrees on Royal Dublin Society's scale	595°	630°	615°	520°	509°	883°	537°	600°	573°	655°	811°
Water	16·10	15·97	17·50	23·30	19·75	—	18·70	14·40	16·60	14·37	8·20
Organic matter, &c. ..	17·52	14·53	12·25	15·70	16·95	37·39	16·59	25·25	28·25	23·98	21·53
Biphosphate	15·92	20·55	19·52	14·36	16·15	11·30	14·30	11·05	12·72	17·40	19·28
Neutral phosphate ..	10·00	13·10	14·90	14·33	6·80	18·00	2·60	4·55	8·55	8·40	16·25
Alkaline salts	4·55	0·80	0·46	2·45	0·52	3·00	trace	3·44	1·95	1·05	1·45
Sulphate of lime	32·89	30·80	29·42	26·11	35·31	27·71	41·41	36·16	27·75	31·10	27·47
Insoluble matter	3·02	4·25	5·95	3·75	4·52	2·60	6·40	5·15	4·18	3·70	5·82
	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00
Ammonia	1·00	0·13	0·12	0·12	0·30	3·62	1·49	2·53	1·40	1·10	1·20

Having pointed out the manner in which the table of equivalents can be used for the purpose of obtaining an accurate expression for the relative total values, we may discuss the data, and endeavour to deduce standards for the two classes of superphosphates.

Mineral Superphosphates.—With the exception of Nos. 1 and 2, all those manures whose analyses are given were sold at £6 10s. per ton to the farmer. By adding in each case one-thirteenth to the number found for Nos. 1 and 2 on the Royal Dublin Society's scale, we can consider them as if sold for £6 10s. per ton each —and therefore compare their number with those given for the remaining samples.

In the following table these corrections have been made :—

Number.	Sold to Farmer at—	Degree on R.D.S. Scale.
1.	£6 10s.	612°.
2.	6 10s.	644°.
3.	6 10s.	630°.
4.	6 10s.	615°.
5.	6 10s.	520°.
6.	6 10s.	509°.

Dismissing Nos. 5 and 6 as being of inferior quality, we have four of these superphosphates, made by different manufacturers, sold at the same price, and approaching closely to each other in the number of degrees reached on the Royal Dublin Society scale. They are undoubt-ed-

* The value of alkaline salts varies chiefly according to the proportion of potash salts present. In my opinion, it would be unfair to *the manufacturer* to assign to them a lower relative value than that *given in the table.*

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useful fertilisers, and their mean number agrees with the mean afforded by my own analyses of corresponding samples. We are therefore in a position to fix our standard of value for a mineral superphosphate as follows:—*Samples marking 620° on the Royal Dublin Society scale above described, should not cost the farmer more than £6 10s. per ton.*

From the foregoing we at once deduce the simple and convenient statement, that a manure marking 600° R.D.S. degrees is worth just *six guineas* per ton.

A single example of the use that I make of this "Royal Dublin Society Standard Mineral Superphosphate" will suffice. Let us suppose that a farmer purchases a sample of mineral superphosphate at £6 10s. per ton, and that on the discussion of its analysis it affords the same number as No. 6, namely, 509° on the R. D. S. scale; we at once report the manure to be value for only £5 6s. 8d.

The money value obtained on the old plan and actually attached to No. 6 by the analyst was £6 7s. per ton. The latter estimation would, therefore, indicate to the purchaser at £6 10s. that he obtained fair value for his money, though really paying about £1 per ton too much. My system at once detects and measures this serious reduction in value.

Bone Superphosphates.—In these cases the equivalent number "8" of a bone phosphate (see table) has been used for dividing the insoluble phosphate; the number 13 being used for the same purpose in discussing the analyses of the mineral superphosphates. The superiority of undissolved bone phosphate over the mineral phosphate in the same condition being thus fully and fairly recognised, the degrees on the R. D. S. scale afforded by the bone manure of course have the same meaning as when deduced from the analysis of a mineral superphosphate. Our standard mineral superphosphate, therefore, measures the value of a bone manure. If, then, the former is only value for £6 10s. per ton, when it marks 620° on the R. D. S. scale, the bone manure is only value for £8 per ton when it reaches 763° on the same scale.

Having deduced our standard from the previous inquiry, we may now ascertain how far the result is confirmed on the discussion of the above given analyses of bone superphosphates.

We first have to raise the equivalent of No. 10 from 573° to 679°, being in the ratio of £6 15s. to £8, and then tabulate the numbers as before, thus:—

Number.	Sold to Farmer.	Degree on R.D.S. Scale.
7.	£8 0 0	883°.
8.	do.	537°.
9.	do.	600°.
10.	do.	679°.
11.	do.	655°.
12.	do.	811°.

Nos. 7 and 12 are derived from vendor's analyses, the rest from those of purchasers. No. 8 is so obviously a very inferior manure that we may dismiss it from consideration. Then, taking the average of the remaining five samples we get as the mean result on the R. D. S. scale 745°. We are therefore fully justified in adopting as a fair standard that which we have deduced from other considerations, namely, 763° *on the Royal Dublin Society scale for a sample of bone superphosphate costing the farmer not more than £8 per ton.*

Having, I hope, shown that the existing system of valuation of superphosphates may be replaced with advantage by another capable of yielding results of higher accuracy and practical value, and having fixed certain standards, by reference to which these artificial manures can be adjudicated upon with fairness alike to the vendor and the farmer; I ought to give notice that all superphosphates sent to the Royal Dublin Society for analysis must now be valued on the above plan.

In concluding this paper I may venture to express the opinion that much public advantage would accrue if the Royal Dublin Society offered some inducement to dealers in superphosphates to compete, on the understanding that the best sample offered at a given price to the farmer should be used as a standard for reference during the season immediately following the competition. However until some such plan is adopted, I venture to think we may fairly rest content with the standards I have now endeavoured to fix.

ON THE

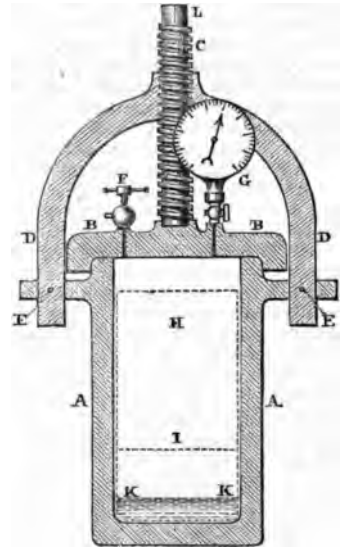
PRODUCTION OF FURFUROL BY THE ACTION OF HIGH-PRESSURE STEAM UPON WOOD.

By GREVILLE WILLIAMS, F.R.S.

(Continued from p. 231).

HAVING shown that furfurol is formed when wood is heated with water to an elevated temperature and pressure, which result has since been confirmed by Mr. Hugo Müller,* I now proceed to give the method by which I found it to be produced by the action of high-pressure steam on the same substance.

The apparatus employed is shown in the engraving. A A is a bronze autoclave, made in one piece, and of great strength. Before being employed it was tested by means of a hydraulic pump, and was found to withstand a pressure of 500 lbs. to the inch without leakage. Before



using the instrument a ring of vulcanised india-rubber was placed between the autoclave and its cover, B B. The screw, C, which serves to keep down the cover, is forced home by means of a wrench applied at L. The arms, D D, serving to support the screw, are affixed to projections on the autoclave, by movable steel pins inserted at E E. A screw-tap, F, enables the product to be distilled over at the conclusion of the operation. The pressures are indicated by the gauge, G. A cylinder of perforated metal, H, is used to contain the substance to be experimented upon; which, in this case, was pine sawdust. The shelf, I, also perforated, prevents contact of the sawdust with the water, the level of the latter being shown at K K.

The water and the charge of sawdust having been introduced, the apparatus was immersed to about half its depth in an oil-bath, the temperature being carefully

* CHEMICAL NEWS, vol. xxvi., p. 247.

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regulated by means of a thermometer. The oil-bath was then heated until the gauge indicated a pressure of 100 lbs. to the inch; this pressure was maintained in some experiments for three, and in others for four hours, the average temperature of the oil-bath being about 198° C. The apparatus having been allowed to cool until the pressure had completely gone down, was then connected with a condensing arrangement. The screw, F, was then loosened, and heat was applied to the oil-bath until about three-fourths of the water present had distilled over. The distillate was strongly acid to test-paper, and smelt decidedly of furfurol, mixed with an empyreumatic odour. On the addition of ammonia it acquired a yellow tint, and in a few hours deposited the characteristic crystals of furfuramide. The crude distillate, mixed with aniline and acetic or hydrochloric acid, instantly gave the magnificent crimson colouration indicative of furfurol. To prove that the crystalline precipitate with ammonia was really furfuramide, I distilled it with a very small quantity of hydrochloric acid; the distillate immediately gave the crimson reaction with aniline. The crystals, treated with acetic acid and aniline, also reacted in the same manner.

From the scale upon which the operation was made, the quantity of furfurol obtained was, however, necessarily small.

The arrangement of the apparatus used in this experiment renders it evident that if the furfurol formed was due to the presence of organic acids, they must have acted in the state of vapour. The experiments I have as yet made seem, however, rather to indicate that the furfurol and the acids are formed simultaneously.

Water alone, and steam alone, being therefore capable —at comparatively high temperatures and pressures—of causing the production of furfurol from wood, I next proceeded to ascertain whether that substance would yield furfurol when distilled with water at normal pressures. I therefore distilled 100 lbs. of sawdust with 100 gallons of water, in a still heated by a copper steam coil: 20 gallons were distilled over. These 20 gallons were put into a small copper still, and the first 10 gallons received. These in their turn were rectified again, and two received. In spite of the concentration which these liquors had undergone, I was unable to obtain furfuramide on digestion with ammonia, and, in fact, they only contained minute traces of furfurol. The high temperature, and consequently pressure, are therefore necessary to the reaction, and this fact forbids the supposition that the furfurol might have been formed during the final process of distillation from the autoclave.

Star Chemical Works, Brentford,
December, 1872.

ON THE HISTORY OF OZONE.*

By Professor ODLING, F.R.S.

Concluded from p. 283.

V.

It has just been remarked that in the action of the contracted gas on iodide of potassium solution, there is absorbed by the reagent, with equivalent liberation of iodine, a weight of oxygen corresponding to a volume equal to that of the original contraction; but very curiously, the absorption by the reagent of this weight of oxygen from the contracted gas was found by Messrs. Andrews and Tait not to produce any further contraction or alteration of its volume; or the weight of oxygen which acted on the iodide of potassium solution appeared to occupy no part of the volume of the contracted gas, its removal from the contracted gas by means of the reagent not affecting any alteration in that volume. Since this *remarkable result* was first announced by Messrs. Andrews and Tait in 1860, it has been adundantly confirmed by von Babo and Claus, by Soret, and by Sir Benjamin Brodie—the modes of experimenting adopted in the original investigation of Andrews and Tait and in the three subsequent investigations, being all different from one another. And moreover, not only has the fact been established by the four several investigations with regard to iodide of potassium, but by one or other of the investigations with regard also to iodine, to mercurous salts, to ferrous salts, to arsenites, and to ferrocyanides. So that, when a given volume of ozonised oxygen is allowed to act upon these different oxidisable bodies, the oxidation effected by the ozone present in the gas is found to be unattended by any diminution in the volume of the gas. An interpretation of this singular result was put forward by the speaker soon after the publication of Messrs. Andrews and Tait's experiments, to the following effect:—Ozone being proved to be a condensed form of oxygen, it is clear that any volume of ozone will contain a greater weight of the matter of oxygen than is contained in the same volume of ordinary oxygen. And since in the action of ozone upon iodide of potassium, the volume of the reacting gas does not undergo any alteration, it is obvious that the oxidation effected must be effected by only so much of the matter of oxygen contained in the volume of ozone as is in excess of the matter of oxygen contained in the same volume of ordinary oxygen. This interpretation, so far as it went, was considered to be demanded by Messrs. Andrews and Tait's experiments, as the only satisfactory explanation of them. With regard to the weight of the matter of oxygen contained in a given volume of ozone, in excess of the weight of the matter of oxygen contained in the same volume of ordinary oxygen, no data whatever existed to show what this weight really is. But relying upon the fact that the weight of oxygen contained in a standard volume of free oxygen is composed of two simple weights of the matter of oxygen, it was conjectured that the weight of oxygen contained in a standard volume of ozone might not improbably be constituted by an introduction into the standard volume of ordinary oxygen of another simple weight of oxygen—equal volumes of ozone, free oxygen, and nitric oxide, for example, being expressible by the comparable formulæ O_3,O_2, and NO respectively. In accordance with this supposition, the action of ozonised gas upon iodide of potassium, &c., is explicable as follows:—The ozone which acts is decomposed into a weight of free oxygen equal in volume to the volume of the ozone, and into another weight of absorbed oxygen, assumed to be one-half of the former weight. The suggestion as to the standard volume of ozone being constituted thus of three simple weights of the matter of oxygen, was admittedly not a necessary deduction from the then known facts, which were indeed equally consistent with its being constituted of four, five, or six such weights; it was only the suggestion of the simplest possible constitution for ozone that was consistent with the facts.

A few years afterwards, in 1865-66, the probability of this being the real constitution of ozone was much strengthened by the results of some experiments conducted by Soret. Operating by a process very simple and ingenious, but scarcely calculated to afford precise results, Soret found that when electrolytically obtained ozonised oxygen was allowed to act upon oil of turpentine, the absorption of the ozone by the turpentine was attended by a diminution in the volume of the gas equal approximatively to twice the initial contraction,—as inferred, of course, from the iodine-titre of the ozonised gas, or from its permanent expansion after exposure to a temporary heat. Supposing the final diminution effected by the turpentine to have been exactly twice the initial contraction, inferred from the iodine-titre, it is clear, that while the original gas would have suffered altogether a diminution of three volumes, the ozonised gas would have suffered a diminution of only two volumes. Or there would have been ultimately abstracted from the original un-

* *Read before the Royal Institution of Great Britain.*

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gas three volumes of the matter of oxygen, occupying in the contracted or ozonised gas, submitted to the action of the turpentine, only the bulk of two volumes. But as a mean result of Soret's first set of five experiments, the final diminution effected by the turpentine was 2·40 times the original contraction; while, as a mean result of his second set of seven experiments, the final diminution was 1·81 times the original contraction. Assuming, however, ozone to have the constitution expressed by the symbol O_3, its specific gravity, and consequently its diffusion-velocity, would approximate closely to the specific gravity and diffusion-velocity of carbonic acid gas, CO_2; and in 1867, Soret, in corroboration of his previous absorption results, satisfied himself that the diffusion-velocity of ozone really does approximate very closely to that of carbonic acid.

VI.

During the last few years, the quantitative reactions of ozone have been made the subject of an elaborate study by Sir Benjamin Brodie, whose results constitute indeed "a body of exact information as to the chemical properties of ozone, through which it may be hoped that this important question will be finally removed from the domain of arbitrary speculation and brought within the precincts of science." In Brodie's experiments, a quantity of pure perfectly dry oxygen, after having been submitted to electrisation by its passage through a modified form of Siemens's induction tube, carefully maintained at a low temperature, was collected in an oil of vitriol gas-holder, to the amount of four or five thousand c.c. From the store of ozonised gas thus collected, which was found to maintain its proportion of ozone without appreciable deterioration for some hours, portion after portion was allowed to pass into a pipette of about 250 c.c. capacity, by displacement of the oil of vitriol originally filling it; and successive equal volumes of the store of ozonised gas so measured off, were submitted one after another to the action of the same or of different reagents, by the passage of each pipetteful of gas through a small bulb-tube containing the reagent in solution. The gas, freed from all ozone by its passage through the reagent, was next received into a mercurial measuring cylinder, in which it was expanded to a definite volume; and then, by reading off the pressure at which it occupied this volume, its proper volume was ascertained. Finally the difference between the capacity of the pipette and the volume obtained in the mercurial cylinder showed the volume of the gas absorbed by the reagent,—the weight of this gas being determined directly or indirectly by titrations of the reagent. Of course, very many points of detail in the construction and use of the apparatus had to be attended to, in order to ensure trustworthy results; but, both in its principle and general working, the process is exceedingly simple. One essential novelty consists in the application of that very useful instrument, the pipette, to the purposes of gas analysis; and by its aid, results having a degree of accuracy far greater than those furnished by any previous method of ozone investigation, were found to be obtainable with both speed and facility.

Operating, then, with the apparatus just described, Brodie has succeeded in established three perfectly definite classes of ozone reactions,—the first of them including the instances previously made known by Andrews and Tait. In this first class of reactions, of which there are several distinct varieties, the absorption or decomposition of the ozone present in a mixture of ozone and oxygen, is unattended by any diminution in the volume of the gas; or a volume of ozone O^{2+x}, is resolved into an equal volume of free oxygen, and an indefinite weight of other oxygen, either absorbed or set free. This class of reactions accordingly does not afford any information as to the value of x, or, in other words, as to the relationship of the formula O^{2+x} to the formula O^2.

Unit-vols.

$$\overbrace{O^{2+x} = O^2 + xO}\ \text{absorbed.}$$

In a second class of reactions, the absorption or decomposition of the ozone present in a mixture of ozone and oxygen is attended with a diminution in the volume of the gas, equal to half the volume that the weight of oxygen absorbed would occupy in the free state. In this class of reactions, then, one of but two occurrences must happen: either the ozone present in the mixture of gases is absorbed wholly without decomposition, in which case the density of ozone must be twice that of ordinary oxygen, and the formula O^{2+x} become O^4; or the ozone present in the mixture is decomposed into half its volume of oxygen liberated, and into a quantity of oxygen, corresponding to its entire volume, absorbed; in which case the density of ozone must be one and a-half that of ordinary oxygen, and the formula O^{2+x} become O_3.

Unit-Volumes.

$$\left.\begin{aligned} \overbrace{O^{2+x} = nil} + 4O \\ 2(O^{2+x}) = O^3 + 4O \end{aligned}\right\}\ \text{absorbed.}$$

In a third class of reactions, the absorption or decomposition of the ozone present in a mixture of ozone and oxygen is attended with a diminution in volume of the gas, equal to two-thirds the volume that the weight of oxygen absorbed would occupy in the free state; or the weight of the gas absorbed is to the weight of an equal volume of oxygen as 3 to 2. But consistenly with this class of reactions, the density of ozone must necessarily be one and a-half times that of ordinary oxygen, and the formula O^{2+x} must become O^3.

Unit-Vols.

$$\overbrace{O^{2+x}) = nil} + 3O.$$

This last and most important class of reactions, by which the formula of ozone as O^3 is put beyond question, was established by a long series of experiments, made chiefly with a neutral or but slightly alkaline solution of hyposulphite of soda, and in a few cases with oil of turpentine. As a result, the ratio of the entire diminution in volume suffered by the original oxygen, to the diminution in volume of the electrised or contracted oxygen effected by the reagent, was found to be, as a mean of twenty-seven concordant experiments made with the hyposulphite, 3·02 to 2·02; and as a mean of eight concordant experiments made with the turpentine, also as 3·02 to 2·02. But neither with the hyposulphite nor with the turpentine could the weight of oxygen absorbed by the reagent be determined, otherwise than by a calculation from the alteration in volume of the gas. A direct determination, however, was effected in the case of a few experiments made with protochloride of tin, under conditions carefully considered and regulated so as to ensure a trustworthy result. And it was found, in these few experiments, that the weight of the matter of oxygen absorbed from the ozonised gas by the tin salt, was almost exactly three times the weight of the matter of oxygen absorbed from the same gas by iodide of potassium,—the volume occupied by the weight of oxygen absorbed by the tin salt being almost exactly twice the volume proper to the weight of oxygen absorbed by the iodide of potassium.

Independently of the importance attaching to the actual determination of the density of ozone, Sir B. Brodie's result has a further interest for chemists, which it would be difficult to exaggerate. The principal of the elementary bodies, known to chemists in the gaseous or vapourous state, are hydrogen, chlorine and its congeners, oxygen, sulphur, nitrogen, phosphorus, arsenic, mercury, and cadmium. Now it is a fact that the weight of phosphorus or arsenic contained in any volume of phosphorus or arsenic vapour is four times the weight of phosphorus or arsenic contained in the same volume of phosphoretted or arsenetted hydrogen, and of a host of other phosphoretted or arsenetted gases or vapours. It is also a fact that the weight of hydrogen, chlorine, oxygen, or nitrogen contained in any volume of each of these elementary gases, is twice the weight of hydrogen, chlorine, oxygen, or

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nitrogen contained in the same volume of a variety of hydrogenous, chlorinous, oxygenous, or nitrogenous compound gases. It is also a fact that the weight of mercury or cadmium contained in any volume of the vapour of either element is identical with the weight of the element contained in the same volume of the vapour of all its hitherto examined volatile compounds. But now a variety of oxygen is shown to exist, the weight of any given volume of which is three times the weight of oxygen contained in the same volume of the simplest of oxygenous compounds respectively, thus :—

Unit-Volumes.

P_4	O_3	O_2	Hg
PCl_3	CO	NO	$HgCl_2$.

The question, then, naturally arises, how long will it be before another variety of oxygen is recognised, the weight of any given volume of which, like that of a given volume of phosphorus vapour, shall furnish the weight of the element contained in four such volumes of its several simplest compounds? And again, how long will it be before yet another variety of oxygen is recognised, the weight of any given volume of which, like that of any given volume of mercury vapour, shall furnish but the weight of the element contained in the same volume of its several simplest compounds? There is the strongest indirect reason for believing in the existence of such a unitary oxygen. For in its reactions, oxygen behaves as a sort of more active electro-negative counterpart of electro-positive mercury Hg; and like mercury, Hg, and unlike hydrogen, H_2, and chlorine, Cl_2, it enjoys the property of adding itself to a pre-formed unit of substance by an indivisible proportion.

PASSAGE OF HEAT RAYS THROUGH INCLINED DIATHERMANOUS PLATES.

(Concluded from p. 269).

In the first part of Professor Knoblauch's paper, the influence of polarisation of heat rays is investigated, apart (as much as possible) from the absorbent nature of the plates. The latter influence falls now to be considered.

A series of experiments are detailed, in which glasses of various colours were employed, the number of plates and angle of incidence being varied several times for each. The more prominent results from this part of the enquiry are these:—

(1). Where parallel heat rays fall on parallel diathermanous plates (varying in number), and where, with perpendicular incidence, the quantity of heat transmitted through different numbers of plates, is, through a special arrangement made in each case, the same; then, on varying the angle for any one number of plates, the heat transmitted is less, and this in proportion as the substance is less diathermanous. This occurs also whether the heat rays are unpolarised, or polarised, in any plane. For the same angle of incidence and the same number of plates, the transmission, as indicated by the multiplier, was greatest with colourless glass, smaller with yellowish green, still smaller with blue (bright blue giving more than dark), and smallest with bluish green glass.

(2). When the incident heat is unpolarised (or polarised at 45°), then, through the partial polarisation which is produced on refraction in the plate (and the plane of which is at right angles to the plane of refraction), the decrease, due to absorption in the aforementioned case, is at first prevented more or less in proportion as the substance of the plate is more or less diathermanous; but a very much faster decrease of the heat appears after the angle of polarisation is passed. Thus, with colourless and yellowish green glass, the heat intensity continued constant till the angle of incidence, 55°; with the bright blue till 25°; whereas with dark blue and bluish green a decrease began at 15°, and this increased greatly after 55°.

(3). When the heat rays were perfectly polarised before entrance into the plate, and the planes of polarisation and of refraction coincided, then, with increasing incidence and number of plates, the transmission was diminished, but the diminution was greater than in the previous case, and also greater the less diathermanous the substance of the plates.

(4). On the other hand, when the original polarisation was such that the planes of refraction and polarisation crossed at right angles, then, till the angle of incidence exceeded the angle of polarisation, there was not only no decrease of the transmitted heat, but a positive increase, and this was the greater in proportion as the plates were more diathermanous. Sometimes the maximum transmission was reached before the angle of polarisation. When this angle was passed, the decrease which took place was always less than in the case of unpolarised rays. The increase of the plates favoured the increase now referred to, and this influence is more marked the more diathermanous the substance, till continued increase of the angle of incidence and number of plates produces decrease of transmitted heat.—*Pogg. Ann.*

A. B. M.

THE QUANTITATIVE ESTIMATION OF MANGANESE IN SOILS AND IN THE ASH OF PLANTS.

By A. LECLERC.

The ordinary gravimetrical methods of estimating manganese in soils and in the ashes of plants are not sufficiently correct to yield good and reliable results, unless, indeed, a very large quantity of material is operated upon at the same time.

The method which I propose and expound in this paper is a volumetrical one, which may be rapidly, yet accurately, performed. The plan consists in the conversion of nitrate of manganese into a permanganate, and the titration of the latter by means of a suitable solution. The conversion just mentioned is readily effected by the aid of red-lead, because the iron and aluminium, the only substances which could react upon the permanganate, are at the time of the conversion already peroxidised. The reaction alluded to will always succeed, provided there be no chlorine present in the substances employed.

Before detailing the quantitative operation, it is necessary to describe the practical details of the experiments. When a soil (arable or other) is to be operated upon by nitric acid, it is first necessary to destroy the organic matter it contains by igniting the soil to red heat. It is next boiled with nitric acid, care being taken not to evaporate the solution to dryness, since, owing to the fact that the nitrate of manganese is decomposed, at 142°, into MnO_2, which is insoluble in nitric acid, manganese might be lost. When the nitric acid appears to have taken up all the manganese, the liquid is filtered, and then diluted with water up to a given and determined bulk. A fraction of this fluid, viz., that in which the chlorine has been estimated by means of nitrate of silver, is next boiled in a porcelain capsule, and after boiling, some red-lead is added, care being taken to stir the fluid. The result is, that the fluid assumes a beautiful violet colour, due to permanganate of potassa, the colour being somewhat masked by that of the peroxide of lead, which is simultaneously formed and deposited in insoluble condition. The depth of the violet colouration depends upon the greater or less amount of manganese present. If it should happen that the red-lead be not acted upon, it is due to the liquor not being sufficiently acid, and consequently some more nitric acid will have to be added. The peroxide of lead having been precipitated, the liquor is filtered through asbestos free from chlorine. The filtrate is then ready for titration, the liquid containing a slight excess of

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nitric acid, permanganate of potassa, nitrate of lead, salts of iron, alumina, magnesia, lime, soda, and potassa. Titration by means of the double sulphate of iron and ammonia is out of the question, because the formation of sulphate of lead would prevent the end of the reaction from being seen, and oxalic acid cannot be used, both on account of its giving rise to the formation of carbonate of lead, and because it requires a higher temperature. I therefore looked for another reducing agent which would allow me to observe correctly the change of the violet to another colour; the nitrate of protoxide of mercury I found to answer my purpose in this respect. This salt is rapidly converted into the nitrate of peroxide of mercury by the permanganate, and the end of the reaction is marked either by a yellowish green colouration, when much manganese is present, or by complete decolouration of the fluid if only a little of the metal is present. The solution of subnitrate of mercury does not form any precipitate, unless, indeed, too much manganese were present, but care should be taken that the liquid to be titrated is rather freely acid, because otherwise sesquioxide of manganese is thrown down. The solution of subnitrate of mercury is first titrated by means of permanganate.

Description of the Experiments.

Expt. 1.—50 grms. of soil are treated, as above indicated, with nitric acid, the liquid is filtered, and the filtrate diluted to 1000 c.c. Three titrations, made with 100 c.c. each, have, on an average, given the following results:—3·39 c.c. of subnitrate of mercury (1 c.c. thereof = to 1·121 m.grm. of Mn), corresponding to $1·121 \times 3·39 = 3·8102$ of manganese. 50 grms. of the same soil, to which have been first added 10 c.c. of a titrated solution of permanganate (this liquid containing 2·366 m.grm. of manganese to the c.c.) have been treated in the same way, and five titrations, made with 100 c.c. each, have given, on an average, 5·51 c.c. of subnitrate used, corresponding to $1·121 \times 5·51 = 6·1767$ m.grm. of manganese. According to these estimations, there would be an increase of $6·1767 - 3·8102 = 2·3665$ of manganese, corresponding to the quantity added, for 100 c.c., to the soil in the shape of permanganate. We have therefore—

Manganese found by analysis	2·3665	m.grm.
Manganese added..	2·3660	,,
Difference, an excess of	0·0005	,,

Expt. 2.—5 grms. of ash have been treated in the same way as the soil. The filtrate having been diluted to 500 c.c., the titrations made with 50 c.c. give an average of 14 c.c. of subnitrate used, corresponding to—

$1·121 \times 14 = 15·694$ m.grm. of manganese.

To 5 grms. of the ash have been added, after treatment with nitric acid, 5 c.c. of permanganate (5 at 11·830 m.grm. Mn); the filtrate having been diluted to 500 c.c., the average of the titrations made with 50 c.c. shows that 15·055 c.c. of subnitrate of mercury have been used, corresponding to $1·121 \times 15·055 = 16·8766$ m.grm. of manganese. Accordingly there is an increase of manganese for $16·8766 - 15·694 = 1·1826$ m.grm. of manganese, a quantity corresponding, for 50 c.c., to that added to the ash, and we have therefore—

Manganese added..	1·1830	m.grm.
Manganese found..	1·1826	,,
Difference, *minus*	0·0004	,,

The author adds to this paper a very extensive tabulated form, showing the results of a series of experiments made with various soils of different geological formations, from which it appears that the method above-mentioned yields very accurate results. We do not here give this tabulated form, because the figures quoted relate particularly to French soil, but as instances we quote the following figures:—

	Mn_2O_3, per cent.
Alluvial soil (Toulouse)	0·078
Granite (Remiremont)	0·060
Chalk formation (Yonne)..	0·276
Sandstone (Vosges) varies from 0·037 to	0·1860
Ashes of plants—	
Oak	1·4880
Fir tree..	4·5070
Lime tree	3·7440
Vine (stem)..	0·1910
,, (root)	0·1300
Grain—	
Wheat	0·0113
Rice	0·0010
Pulverised bones	0·0061
,, coprolites..	0·1460

The theory of the method above described is exhibited by the following formula—

$$Mn_2O_7,KO + 4Hg_2O,NO_5 + 5NO_5 = \\ = KO,NO_5 + 8HgO,NO_5 + Mn_2O_3.$$

The supposition of the precipitation of Mn_2O_3 has been verified by experiment. The precipitate, on being tested after titration, has been found to be sesquioxide of manganese.—*Comptes Rendus.*

MINERALOGY.

THE third lecture of the series, by W. W. Smyth, F.R.S., on Monday evening, November 25, was on "Silica, or Quartz and its Varieties."

The term crystal (from the Greek *crystallos*, ice) was first applied to crystal of quartz or rock crystal; which was regarded as a variety of ice. It belongs to a class of minerals characterised by having silica for their chief constituent, and of which it is the purest variety. Its crystals belong to the hexagonal system, quartz crystals usually assuming the form of a six-sided prism, terminated at both ends by a six-sided pyramid. The largest and most beautiful crystals are from Madagascar. The substance is extremely hard, and cannot be scratched by steel, and can only be worked by taking advantage of its brittleness. The substance used for "pebble spectacles" and "pebble lenses" is crystalline quartz, brought chiefly from Brazil; and is valuable for these purposes not only on account of its transparency, but especially on account of its coolness. A less crystalline variety is known as common quartz, and is exceedingly interesting as being in many cases the matrix in which gold is found in the mining districts. Some fine specimens of this auriferous quartz from California and Australia may be seen in the Geological Museum.

The lecturer exhibited a fine specimen of quartz to illustrate the phenomenon of pseudomorphism, which was full of casts of crystals of cubic and rhombohedral form, in the latter of which forms quartz is very seldom found crystallised, and never in the former. He explained their origin by supposing the quartz to have been deposited round crystals of some other materials (*e.g.*, in veins) which have since been removed. Quartz is very frequently found filling up fissures in the rocks, or forming veins, and in some of these veins valuable mineral ores are found, for example, the tin ores of Cornwall. Galleries are driven in the rocks, and the whole of the material in the productive veins removed with the exception of bars at various levels, left as floors and to prevent the side walls from collapsing. Many serious accidents have occurred by the giving way of these masses, both in California and in our own country. If any circumstance has prevented the quartz from attaining its proper degree of coherence and hardness, or if any impurity is present (*e.g.*, a thin layer of clay) to destroy its continuity, it is quite unsafe to work underneath these galleries.

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Jasper is a variety of quartz of a red, brown, or greenish tint. Caerngorm is another variety which is obtained from the mountain of that name in Scotland. "Smoky quartz" is so named from its smoky appearance; and "rose quartz" from its tint, which is due to the presence of a metallic oxide. Amethyst likewise belongs to the quartz family of minerals, and has a beautiful purple tint. It owes its name to a strange fancy regarding it in olden time, namely that the wearer of it was preserved from inebriation. Under the term "agate" a large number of minerals are arranged, which agree in being made up of layers or bands of material, coloured more or less distinctly. They are often found wholly or partly filling up the hollows of certain cavernous substances, and appear to have been deposited from solution in water. If the layers are strongly contrasted, as black and white, the name onyx is given to it, and if in addition to these a reddish layer is present it is called sardonyx. Avanturine is a brownish mineral containing numerous little plates of mica, which act as so many spangles in reflecting the light.

Calcedony (of which certain stalactitic forms are known) carnelian and sard also belongs to this class. With respect to sard, the lecturer took occasion to call attention to those exceedingly beautiful "engraved gems," which he characterised as examples of the highest art-workmanship of antiquity which has come down to us. The beautiful polish which the substance is capable of taking, and its great durability, made it to be much valued by ancient lapidaries. And both these qualities rendered it and allied substances well fitted for cutting into signet rings, which in those times were objects of such common use.

In the form of sandstones quartz is in common use for building proceses. It has been reduced to this form by the action of the waves and other agencies, and can be easily worked and split up into flagstones, &c.; sometimes sufficiently thin as to be used for roofing materials. Grit is a coarser form of a similar nature; and a coarser still is known as "plum-pudding stone."

An amorphous variety of quartz minerals, containing from 4 to 7 per cent of water, is termed opal. This is one of the most interesting varieties of the family, as showing the probable mode of their formation. It appears to have been deposited from water, and in some cases, as at Antigua in the West Indies, and in Hungary, trunks of trees and pieces of wood are found completely opalised. Noble, or precious opal, is found in Hungary very near to places where the mineralised wood occurs.

In Iceland and New Zealand, at the present day we see an example of siliceous matter being deposited from hot water. The orifices of the Icelandic geysers are surrounded by basins composed of this siliceous sinter, which is likewise deposited on materials placed in the water. The lecturer had a specimen of a stick thus silicified in the water of these springs. He had also an illustration of a very curious mode of rock formation by means of hot springs in North Island, New Zealand, which consists of a natural cascade formed entirely from the siliceous matter deposited from boiling springs. The various steps of the cascade were circular or basin shaped, and were all seen to be overflowing with water. In conclusion he said that probably these hot mineral springs had been the chief agency in filling up the veins in the rocks.

"Silicate Minerals and the Silicate Gems" was the subject of the fourth lecture of the course by W. W. Smyth, F.R.S., delivered at the Geological Museum on Monday evening, December 2nd.

Silicates are substances which contain a large amount of silica (a compound of silicon and oxygen), and of these there are numerous varieties. Some are hydrous, others anhydrous; to the latter class the lecturer proposed to confine his remarks. Gems are mineral substances having an agreeable tint of colour, a certain amount of transparency and brilliancy, and especially a great degree of hardness, enabling them to retain their forms and features for ages; besides the above qualities, rarity is to a certain extent an element in their value. Beautiful substances, wanting more or less the high degree of hardness, were admitted by the Ancients as half-gems.

Amongst the very complicated minerals (as regards their composition) of this class, *chrysolite* is one of the most simple. This term is applied chiefly to large yellowish green crystals of the substance; to the darker green varieties the name *peridote* is given; while, under the name of *olivine*, the substance is found disseminated throughout many rock masses, especially the basalts (as those of Fingal's Cave, Giant's Causeway, &c.), and also in meteorites. In meteorites from the desert of Atacama, crystals of chrysolite are found. The average chemical composition of this and other minerals of the same class is given in the following table:—

	$\ddot{Si}$.	$\ddot{Al}$.	$\dddot{Fe}$.	$\dot{Mg}$.	$\dot{Ca}$.	$\dot{Na}$.	$\dot{K}$.	
FELSPAR (Adularia)	65·69	17·97	—	—	1·54	1·01	13·99	Mn
Ditto (Amazon stone)	65·32	17·89	0·30	0·09	0·10	2·81	13·05	0·19
			$\dot{Fe}$.			$\dddot{Cr}$		
CHRYSOLITE	40·12	0·14	15·32	44·54	—	—	—	0·29
GARNET (Bohemia)	42·08	20·00	1·51	10·20	1·99	3·01	—	0·32
						Beryllia.		
BERYL (Ural)	67·00	16·50	1·00	—	0·50	14·50	—	—
Emerald (Muzo)	68·50	15·75	1·00	Fl	0·25	12·50	0·50	—
TOPAZ (Brazil)	34·24	57·45	—	15·06	Zirconia.	—	—	—
ZIRCON	32·00	—	2·00	—	64·5	—	—	—

Felspar is now employed as a family name for a series of minerals. *Orthoclase* is one of these, which, as the name implies, cleaves with right angles. *Adularia* is another variety, named from Aduli, a mountain in Switzerland; its formula is—

$$\dddot{Al}\,\ddot{Si}_3 + \dot{K}\,\ddot{Si}.$$

One variety of adularia, from its peculiar luminosity, is known as *moon-stone*; and a green variety, from Siberia, as *Amazon-stone*. The porphyries are a peculiar class of rocks containing more or less distinct crystals of various substances in the different varieties; in some districts they are worked as building-stones. A schorlaceous variety, met with only in one district in Cornwall, was employed as the material for the sarcophagus of the Duke of Wellington. Under certain circumstances, felspathic rocks are decomposed, and form the substance known as "kaolin," or "China clay," so largely used by the Chinese for making the finer kinds of porcelain, and, since its discovery in Cornwall and Devon in the last century, applied to the same purpose in this country.

One of the most common of the silicate gems is the *garnet*, which occurs in crystals of large size in many countries. It crystallises as a rhombic dodecahedron, icositetrahedron, and other allied forms, and its formula, in the variety known as *grossularia*, is—

$$\dot{Ca}_3\,\ddot{Si} + \dddot{Al}\,\ddot{Si}.$$

The term garnet is, by jewellers, confined to those stones cut into facets; other specimens of the same mineral, of a deep red colour, when cut *en cabochon* (a jeweller's term to denote a form with rounded faces, or concavo-convex), are known as *carbuncles*. Crystals of it are found in Scotland, but it occurs most abundantly in Hungary, where it is found (especially after floods) in the gravel of rivers. As an example of its abundance there, the lecturer stated that he had bought garnets by the pint from persons in the streets, and that the people there use the small garnets, in the same way as sand is used in some countries, to dry their writing instead of blotting-paper. The *topaz* is another gem of this series, having a crystalline form, in many cases of a four-sided prism ter

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by a rhomb, and with the property of cleavage well developed in directions parallel to the two ends of the crystal. The cleavage-planes are the smoothest and most brilliant faces of the crystal in its natural state, the sides of the prism being minutely striated, and by these simple properties this gem may be distinguished from several other substances which in some respects closely resemble it. It is found in Siberia, in Brazil, and on a small scale in our own islands at St. Michael's Mount, in Cornwall, and in the Mourne Mountains, in Ireland. A very fine collection of specimens from Siberia is now in the British Museum, having been purchased from a Russian officer, Colonel de Kokscharow; they have, however, to be covered with close-fitting caps, to exclude the light, which would prove injurious to their colour. It has generally a yellowish tint, but is sometimes colourless; the pink varieties are artificialy produced by exposure to heat. Its chemical formula is given as—

$$12\dddot{Al}\,\dddot{Si} + (2AlF_3 + 3SiF_2).$$

The gem known to the Ancients under this name appears not to have been the same as that to which we give the name "topaz," but perhaps the crysolite.

The mineral called *beryl*, which includes amongst its varieties the emerald and the aquamarine, crystallises principally in a six-sided prism with flat terminations, but often these terminal planes are replaced by other forms. Its formula is—

$$\dddot{Al}\,\dddot{Si} + BeSi,$$

and the percentage composition of two varieties is given in the table above. Beryl occurs as a greenish, bluish, or greyish mineral, either opaque or translucent; its finest green varieties are known to us as "emerald," while a paler species is termed "aquamarine," as bearing a fancied resemblance in colour to sea-water. As *emerald*, it is very highly valued, and the Ancients were very high in their praises of it; though there is very much difficulty in ascertaining the exact locality whence they obtained it, there is reason to believe that some specimens were from a district in Upper Egypt. Their strange traditions about its being jealously guarded by griffins are capable of a probable rational explanation. They also probably confounded, in many instances, a very different mineral, known as "copper emerald" (having a similar appearance), with the genuine stone; and, indeed, the inferior mineral is now sometimes mistaken and offered for sale as real emerald. The finest emeralds of the present day are brought from Muzo, a district in New Granada, where it is found imbedded in a black limestone. A very fine cylindrical specimen of this gem is set in the tiara of the Popes.

NOTICES OF BOOKS.

A Practical Treatise on Pure Fertilisers, and the Chemical Conversion of Rock Guanos, Marlstones, Coprolites, and the Crude Phosphates of Lime and Alumina generally, into Various Valuable Products. By CAMPBELL MORFIT, M.D., F.C.S. London: Trübner and Co.

THE need of a thoroughly practical work on the manufacture of chemical manures has long been felt. We are happy to find that the deficiency has been supplied by Mr. Campbell Morfit, a chemist who has for years directed his attention to this important subject. It is interesting to find that the author pronounces the sewage of towns to be the true manure, and regards "superphosphate" and similar preparations as mere temporary substitutes, to be laid aside as soon as the great sewage question is thoroughly solved. This solution, we are happy to find, he seeks not in "irrigation," but in "precipitation."

Mr. Morfit points out clearly the defects attending the ordinary system of rendering phosphatic minerals soluble. Commercial "superphosphate," he shows, contains more or less of the raw material in an unconverted state, along with a variable amount of free acid. Its greatest possible proportion of soluble phosphate is 32 per cent, whilst in ill-made and adulterated samples this constituent may fall as low as 10 or 15 per cent. The phenomenon known as "going back," so unpleasant both to producers and consumers, he ascribes to the presence of unconverted material. "It is the undecomposed portion of triphosphate of lime," he observes, "which exists almost invariably in the ordinary commercial superphosphates, that causes the biphosphate portion to 'go back,' according to trade language, or become directly insoluble in water."

In place of these superphosphates the author recommends "precipitated phosphate," "Columbian phosphate," diphosphate, chlorophosphate, and sulphited phosphate. The processes for preparing these fertilisers, as directed by Way, Deligny, Gerland, and the author himself, are clearly described, with the addition of diagrams of the machinery and plant required, drawn to scale. For Gerland's "sulphited phosphate" he claims a very high rank as a disinfectant and deodoriser, and points out the ease with which it can be manufactured in regions where acids are not procurable. In its production he tells us—"Sulphuretted ores may be substituted for sulphur; and this means of concentrating them, by roasting, for more economical transportation to distant markets or smelting-works, opens a way for the profitable production of the sulphite of tri-phosphate of lime in those remote places where crude phosphate material abounds, and sulphuric acid is to be obtained only at a cost which is too great for its employment in the usual processes of manufacturing fertilisers."

It must, however, be admitted that to introduce these "pure fertilisers" into the market will be a work of time and of difficulty. One reason why so many low-class manures are made and sold is the outcry for cheapness. Double the strength of your product, and you will not always find it practicable to obtain double the price.

The author furnishes a list of normal fertilisers adapted for different crops, which may, we think, be advantageously studied alike by manure manufacturers and farmers.

In his valuable sections on the analysis of manures and phosphatic minerals, Mr. Morfit makes a remark which cannot be too widely circulated:—"The phosphoric acid is thus shown in its individual combinations, and not totalised as tri-phosphate of lime, according to the meretricious style of 'commercial' chemistry."

Without declaring ourselves satisfied with every view advanced in these pages—especially as regards the cost of producing manures—we can conscientiously recommend the work to the careful study of all our readers who are interested in the application of chemistry to the oldest and most important of the arts.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, December 9, 1872.

In addition to papers relating to mathematico-physical and natural history sciences, this number contains the following original papers and memoirs relating to chemistry:—

Observations on some Groups of Isomeric Substances Derived from the Fermentation Alcohols.—I. Pierre and E. Puchot.—This exhaustive essay, elucidated by a large number of

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formulæ and tables, contains a comparative review of the boiling-point, sp. gr. at 0°, sp. gr. at the temperature of ebullition, and other physical characters of several groups of centesimal isomeric bodies derived from fermentation alcohols. It appears that there is a great difference of properties among this group, while in the *isomères par réciprocité* there is scarcely any difference at all.

On Dibenzyl-dicarbonic Acid.—A. P. N. Franchimont.—This essay records in the first place the results of experiments made for the purpose of obtaining an acid of the following constitution:—

$$C_6H_5-CH(CO_2H)_2;$$

but this not having succeeded, another mode of experimenting was adopted with the result that by a complex process the author prepared an acid, the empirical formula of which is $C_8H_7O_4$. This is a solid crystalline substance, fusing at 222°, readily soluble in alcohol, and forming with that fluid an ether which is also a solid body. The constitutional formula of the acid is—

$$\begin{array}{l} C_6H_5-CH-CO_2H \\ \quad\quad\quad | \\ C_6H_5-CH-CO_2H. \end{array}$$

Splitting into Two (dédoublement) of Hydrate of Chloral by the Joint Action of Glycerine and Heat.—H. Byasson.—In the first portion of this paper the author reviews his former researches on this subject, and next gives details of the results of experiments made to ascertain whether, considering that hydrate of chloral contains the elements of chloroform and formic acid—

$$(C_4HCl_3O_2,H_2O_2=C_2HCl_3+C_2H_2O_4),$$

it would not be possible to split up the body by the aid of glycerine and heat into chloroform and formic acid; the result is that at a comparatively low temperature, beginning at 110° and continuing up to 230°, there is formed chloroform (on an average 31 per cent for the quantity of hydrate of chloral operated upon) and formiate of allyl boiling at between 83° and 85°, sp. gr. 0·934. Very concentrated glycerine is required to be used in this experiment.

Note on Parathionic and Thioamylic (Isomeric with Sulphoamylic) Acids met with in the Mother-liquor of Coralline.—A. Commaille.—The mode of preparation of parathionic acid is first minutely described; this acid as obtained by the decomposition of the lead salt, is a syrup-like fluid, which is neither precipitated by baryta water nor by solution of acetate of lead. The formula of the crystallised lead-salt is $C_4H_8O_7S_2,PbOHO$. The thioamylic acid, also obtained by the decomposition of its lead-salt, is a crystalline substance, very deliquescent; soluble in water and alcohol in every proportion. The formula of the lead-salt of this acid is—

$$C_{10}H_{11}O_7S_2,PbO,HO.$$

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 18, 1872.

This number contains the following original papers and memoirs:—

Ethyl-Cyanocarbonate (Cyan-Kohlensaureäther).—L. Henry.—After briefly referring to the labours of Pinner and Dr. Weddige on this subject, the author quotes some phrases from a paper published by him in the *Comptes Rendus*, vol. lxxi., pp. 314—318, with the view to prove that he has, previous to the above-named authors, obtained the ethyl-cyanocarbonate, but not in sufficiently pure state for further research. The author does not, however, wish this communication to be understood as in the least impairing Dr. Weddige's just claim to the discovery of the compound.

Ethyloxy-Oxalylchloride.—L. Henry.—In the introduction to this exhaustive essay, copiously elucidated by complex formulæ, the author discusses the reactions of the acid chlorides—

$$(C_nH_{2n+1}).CO---Cl,$$

upon the organic zinc compounds, $(C_nH_{2n+1})_2Zn$; and next a discussion follows on the probable results of the behaviour of ethyloxy-oxalylchloride, $C_2H_5O---CO---CO---Cl$, with the zinc compounds referred to. The author further describes at length a series of results of researches; but, owing to the fact that the details would require the reproduction of a large number of complex and lengthy formulæ, we do not enter into further particulars.

Meta-Toluylic Acid.—R. Fittig.—After referring to the researches of Ahrens, Tawildarow, Wurtz, and Richter on this subject, and pointing out the discrepancies of the fusion-point observed by these authors for this acid, the author describes at great length the process by means of which he has prepared perfectly pure meta-toluylic acid, which was found to be slightly soluble in water, to fuse at 105°, and to be distinguished from the ortho- and para-toluylic acids by greater solubility of the calcium salt. This essay further contains the record of researches made, at the author's request, by W. Ramsay, with the view of elucidating the cause of the discrepant results obtained by the above-named authors.

Formation and Decomposition of Formic Acid.—J. Thomsen.—This monograph is a critical review of the labours and researches of Berthelot's thermo-dynamical investigation of this subject. The main conclusion derived from the researches here described is the following:—The thermical behaviour of formic acid exhibits no anomalies; that it is evident that the formation of this from oxide of carbon and water, as well as from hydrogen and carbonic acid, must be accompanied by the evolution of heat, even if hydrate of soda is not present; further, that the phenomena of the decomposition of this acid are not anomalous; and that, lastly, the results of Berthelot's investigation are not correct.

Contribution to our Knowledge on the Chlorine Derivatives of Aceton.—C. Bischoff.—A brief review of the investigation made by L. Glutz and E. Fischer on chlor- and cyan-acetons, and is here published because the author, who has been and is still engaged with researches on this same subject, desires to acknowledge the politeness of Professor Kolbe, who called his attention to the preliminary notices of the researches of the above-named authors published some time ago.

Observations on Monochloraceton.—L. Henry.—In the introduction to this essay reference is made to the researches of Friedel, Da Silva, Reboul, and the former investigation made by the author on this and collateral subjects. Next, the author states that he has obtained, synthetically, acetonic acids (*acetonsauren*)—

$$C_nH_{2n+1}---CO---COOH,$$

and more particularly pyrouvic acid, $CH_3---CO---COOH$, by the action of organic zinc compounds, $(C_nH_{2n+1})_2Zn$, upon the ethyl-oxy-oxallyl-chloride. It is further said that it has been tried to obtain this body by another process, viz., the oxidation of the corresponding alcohol, $CH_3---CO---CH_2OH$. This alcohol, hitherto unisolated, is only known as chloride- and bromide-compound, more commonly called monochloraceton and monobromaceton; the former has been submitted to the action of an alcoholic solution of acetate of potassa, by which, while KCl is formed, the acetate of the ethyl of pyrouvic acid is obtained. This substance—

$$CH_3---CO---CH_2(C_2H_3O_2),$$

is a pleasantly-smelling fluid, bitter taste, and colourless; sp. gr. at 11°=1·053; soluble in water, alcohol, and ether; vapour density=4·0. From this ether the alcohol has not as yet been obtained in free state. The author and Dr. L. Bisschopinck are engaged in researches on the products of decomposition of this ether when acted upon by different reagents.

On Sulpho-Benzophenon, and on a Product obtained by the Distillation of Benzoate of Baryta.—A. Behr.—By the action of alcoholic HKS upon the chloride of benzophenon there is formed sulpho-benzophenon, which, in pure state, is a snow-white crystalline substance, fusing at from 152° to 153°; formula, $C_{13}H_{10}S$. Although this body is readily acted upon by oxidising agents, it is not, strictly speaking, oxidised, the only result being the elimination of sulphur and the formation of benzophenon; while, when the sulpho-benzophenon is submitted to dry distillation, there is formed a fœtid-smelling oil, in small quantity, and tetraphenyl-ethylen. By the dry distillation of benzoate of baryta, the author obtained a hydrocarbon, $C_{28}H_{20}$, which appears to be identical with the hydrocarbon discovered by Kekulé and Franchimont (see Chemical News, vol. xxvi., p. 276). The bromine compounds of this body differ slightly in respect of their fusion-point and the quantity of bromine they contain, and the formation of this compound during the process of the dry distillation of the baryta salt is explained by the author as probably due to the simultaneous meeting of benzol and of benzophenon in nascent state.

Carbonated and Sulpho-Carbonated Derivatives of Isobutyl-Alcohol.—E. Mylius.—This paper contains the description of the following compounds:—Isobutyl-chlorocarbonic acid ether—

$$\begin{array}{l} C_4H_9O \\ \quad\quad\quad >CO, \\ Cl \end{array}$$

a rather unstable fluid, decomposed at its boiling-point, and by water even at the ordinary temperature. Isobutyl-urethan—

$$\begin{array}{l} C_4H_9O \\ \quad\quad\quad >CO, \\ NH_2 \end{array}$$

boils at from 206° to 207°; fuses at 55°. Phenyl-butyl-urethan—

$$\left.\begin{array}{l} C_4H_9O \\ C_6H_5 \\ H \end{array}\right\} N \Big\} CO,$$

a solid crystalline body, fusing at 80°; boiling-point, 216°; difficultly soluble in water, but readily so in alcohol and ether. Toluyl-carbaminic acid butyl-ether—

$$\left.\begin{array}{l} C_4H_9O \\ C_7H_7 \\ H \end{array}\right\} N \Big\} CO,$$

an oily fluid; boiling-point, from 275° to 280°; not solidified at −10°. Butyl-xanthonate of potassium—

$$\begin{array}{l} C_4H_9O \\ \quad\quad\quad >CS_2, \\ KaS \end{array}$$

a yellow-coloured crystalline salt, soluble in alcohol; by dry distillation it yields oxide of carbon, butyl-sulphide, and sulphuret of potassium. Butyl-xanthonate of sodium—

$$\begin{array}{l} C_4H_9O \\ \quad\quad\quad >CS, \\ NaS \end{array}$$

Butyl-xanthonate of ethylic ether—

$$\begin{array}{l} C_4H_9O \\ \quad\quad\quad >CS, \\ C_2H_5S \end{array}$$

boils at from 227° to 228°; sp. gr. at 17°=1·003. Butyl-xanthonate of butyl-ether—

$$\begin{array}{l} C_4H_9O \\ \quad\quad\quad >CS; \\ C_4H_9S \end{array}$$

boiling-point, 247° to 250°; sp. gr. at 12°=1·009. Butyl-xanthonate of amyl-ether—

$$\begin{array}{l} C_4H_9N \\ \quad\quad\quad >CS, \\ C_5H_{11}S \end{array}$$

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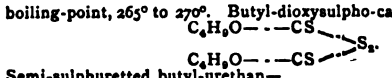
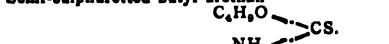
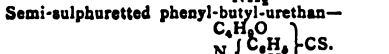
boiling-point, 265° to 270°. Butyl-dioxysulpho-carbonate—



Semi-sulphuretted butyl-urethan—



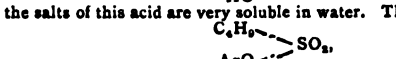
Semi-sulphuretted phenyl-butyl-urethan—



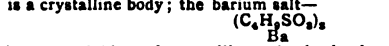
The mode of preparation of these substances is minutely described.

Contribution to our Knowledge on Butyl-Sulphydrate.—E. Mylius.—While the author's researches confirm those of Humann (*Ann. Chem. Pharm.*, vol. xcv., p. 256) on the action of nitric acid upon isobutyl-mercaptan, the main product of the action of nitric acid at 1·30 sp. gr. upon the mercaptan just mentioned is the formation of isobutyl-sulpho acid—

the salts of this acid are very soluble in water. The silver salt—



is a crystalline body; the barium salt—



is very soluble and crystalline; the lead-salt cannot be obtained in pure state, since basic salts are formed of an indefinite composition.

Action of Phosphorus upon Alkaline Metallic Solutions.—A. Oppenheim.—Reserved for full translation.

Polytechnisches Journal von Dr. E. M. Dingler, first number for November, 1872.

This number contains the following original papers and memoirs relating to chemistry and collateral subjects:—

Researches on the Gold Assay as Practised at Mint-Works.—Dr. H. Röszler.—This essay, elucidated by several tables exhibiting the results of experiments, treats at length on the ordinary gold assay (by the dry way). The general result of the author's researches is that, *ceteris paribus*, gold of lower purity (more alloyed), which has to be treated with much lead, will yield on cupellation a worse result than a purer alloy when treated precisely in the same way; and further, that when, by the fine-gold test (*feingold probe*), the loss of gold is compensated for by the quantity of silver retained, the loss of gold, when more base alloys are assayed, exceeds the quantity of silver retained—in other words, that the results of cupellation in the latter case always indicate too low a quantity of gold.

The Future of the Gold-Plating Industry.—Dr. C. Winkler.—This essay treats on the present state of this industry in Germany, and on the improvements still to be made in the manufacture of imitation jewellery.

Industrial Method of Withdrawing the Fusel Oil from Crude Spirits by means of Charcoal.—Dr. W. Schultze.—This lengthy paper enters into minute details on the following matters:—Preparation of the charcoal; the size of the lumps of the charcoal and the process of operating; on the influence of the air in the pores of the charcoal; the influence of the porosity of the coal; defuselisation and the degree of dilution of the spirit; defuselisation and the duration of contact between charcoal and spirits.

The Methods of Petroleum Collection (viz., from the Soil by Borings, &c.) in Use in America and Galicia.—A. Fauck.

Filters Made from Spun and Felted Glass.—P. Weiskopf.—At the request of the Austro-Hungarian government, the author has made a series of experiments to ascertain whether finely-spun glass-thread can be felted and made into a suitable shape for the purpose of filtering. The author has used pure hard Bohemian glass for this purpose, and finds it to answer exceedingly well and to filter rapidly, as well as yielding a perfectly clear filtrate. The author will send glass wool, as he terms it, from his residence at Morchenstern, in Bohemia, to those who feel interested in this matter.

Second number for November, 1872.

This number contains the following original matter relating to chemistry and collateral subjects:—

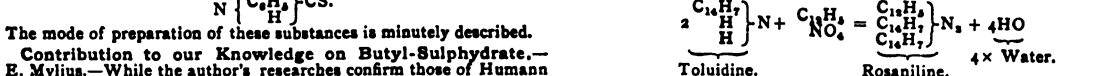
Calcining Furnaces Invented by Hasenclever and Helbig for the Purpose of Desulphurising Ores so that the Sulphur may be used for Sulphuric Acid Preparation.—R. Hasenclever.—This memoir, illustrated by engravings, contains the detailed description of a furnace so constructed that the metallic ores which contain more or less sulphur can be so calcined that the sulphur may be readily utilised for the preparation of sulphuric acid.

Theory of the Nucleus Formation (Kernbildung) during the Roasting of Cupreous Pyrites.—A. Schertel.

Essay Containing an Enumeration of the German and Best Known Foreign Clays (for Ceramic Purposes) According to their Geological Occurrence in the Tertiary and Older Formations.—Dr. C. Bischof.—This essay contains a review of the various and best known clays used for ceramic purposes.

Softening of Water by the Aid of Lime-water.—J. Stingl.—This monograph, elucidated by a series of results of analyses of water, treats on the precipitation of a large proportion of the dissolved earthy matters contained in natural waters by the aid of lime-water, which has, however, to be used only in comparatively small quantity, to be regulated by the composition of the solid matter dissolved in the water.

Preparation of Fuchsine without Arsenic Acid.—Dr. Dingler.—It appears that at the extensive aniline pigment factory of Messrs. Meister, Lucius, and Brüning at Höchst-on-the-Main, the aniline oil is converted into rosaniline by the aid of nitro-benzol. This process, which yields excellent results, may be elucidated by the following formulæ:—



Toluidine. Rosaniline. 4× Water.

Analysis of Raw Sugar, and on the Means by which more Concordant Results may be Obtained by Different Analysts.—Dr. C. Kohlrausch.—Illustrated with woodcuts.

Neues Jahrbuch für Pharmacie, von Dr. F. Vorwerk, October, 1872.

In addition to several papers strictly relating to pharmaceutical science, this number contains the following papers and memoirs bearing upon chemistry:—

Chemical Investigation of the Fruit of the Barberry (Berberis Vulgaris).—Dr. Graeger.—Leaving the stalks, the berries consist, in 100 parts, of—Husks and seeds, 15·58; soluble matter, 17·20; water, 67·22. Chemical composition of the fruit, in 100 parts:—Husks and seed, 15·58; free malic acid, 5·92; grape sugar, 4·67; gum, 6·61; ash of juice, 0·06; water, 67·16; total, 100. Ash of the husks and seeds, 2·20 per cent.

On Hyoscyamine.—Dr. G. Merck.—After observing that this alkaloid is mostly described as a crystalline solid, the author states that more recent research has proved the hyoscyamine only to be obtainable as an amorphous mass, but he adds that if this is gently submitted to distillation with hot water, there is obtained a colourless oily fluid, similar to coniine. This modification of hyoscyamine is readily soluble in alcohol, ether, and water, but only partly soluble in benzin and chloroform. By exposure to air, the fluid hyoscyamine (which exhibits a strong alkaline reaction and neutralises acids completely) becomes dark coloured, thickish, and emits an unpleasant smell. In that condition the hyoscyamine is not more soluble in ether. The oxalate of this base was obtained in crystalline form.

PATENTS.

Communicated by Messrs. VAUGHAN and SON, Patent Agents, 54, Chancery Lane, London, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

3272. J. R. Williams, Manchester, "Improvements in cements."—Petition recorded November 4, 1872.

3278. W. Glazier, Rochdale, Lancashire, "Improvements in treating and utilising certain refuse animal and vegetable substances, and the application of the resulting substances or matters to various manufactures.—Petition recorded November 5, 1872.

3288. H. Harrison, Killenaule, Tipperary, Ireland, "Improvements in the manufacture of artificial or prepared fuel from anthracite dust or 'culm,' or from other coal dust, and in apparatus employed in such manufacture."—Petition recorded November 6, 1872.

3330. A. C. Pelly, Finch Lane, London, "Improvements in the manufacture of peat fuel, and in the machinery and apparatus therefor."—A communication from L. Von Horn, Stockholm.—Petition recorded November 9, 1872.

3460. A. Morgan, South Lambeth Road, Surrey, "An improved method for purifying and amalgamating gum resins, including Kauri gum."—Petition recorded November 20, 1872.

3497. T. H. Cotton, Huddersfield, "A new or improved fuel to be used as a substitute for and to economise coal, and the means of applying the same to feed steam-boiler and other furnaces where steam can be obtained."

3501. J. H. Player, Birmingham, "Improvements in utilising waste products obtained in the manufacture of phosphorus, and in the manufacture of certain metallic compounds containing phosphorus."—Petitions recorded November 22, 1872.

3525. J. Mitchell, Millbank Street, Westminster, "A new or improved cretaceous hydrocarbon fuel."

3529. D. Curror, Wester Craigduckie, Fifeshire, and J. Dewar, Gilmore Place, Edinburgh, "Improvements in the filtration and purification of fluids, and in the manufacture of manure."—Petitions recorded November 25, 1872.

3588. A. V. Newton, Chancery Lane, Middlesex, "Improvements in the manufacture of sugar, and in apparatus to be used therefor."—A communication from S. Dod, Havana, Cuba.—Petition recorded November 28, 1872.

NOTICES TO PROCEED.

2265. A. M. Clark, Chancery Lane, Middlesex, "Improvements in the manufacture of phosphoric acid and acid phosphate of lime, and the applications of the same."—A communication from L. H. Blanchard, Paris.—Petition recorded July 29, 1872.

2331. C. M. T. du Motay, Boulevard de Strasbourg, Paris, "An improved mechanical and chemical method of epurating the cast-irons, in order to allow the same to be directly or indirectly transformed into iron or steel."—Petition recorded August 5, 1872.

2610. J. Noad, Hackney Wick, Middlesex, "Improvements in the

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manufacture of paper-pulp from wood, and in apparatus therefor."—Petition recorded September 2, 1872.

3382. E. A. Cowper, Great George Street, Westminster, "Improvements in separating the fibres of materials producing paper-pulp, and apparatus therefor."—Petition recorded November 13, 1872.

PATENTS SEALED.

1421. J. Robey, Manchester, "A new or improved filtering medium, suitable also as a disinfectant and deodoriser."—Dated May 10, 1872.

1722. T. Gray, New Wandsworth, Surrey, "Improvements in the means of treating vegetable fibres for the manufacture of paper."

1723. J. J. Harrop, Manchester, and W. Corbett, Bradford, Lancashire, "Improvements in puddling iron and in puddling furnaces."—Dated June 7, 1872.

1742. C. A. Faure, Brook Street, Lambeth, "Improvements in the process or processes of applying electric currents to chemical decompositions and combinations, including the manufacture of alkalies."—Dated June 10, 1872.

1885. J. Horsley, Cheltenham, "An improvement in the manufacture of an explosive compound and a new mode of firing explosive compounds."—Dated June 22, 1872.

1905. W. E. Newton, Chancery Lane, Middlesex, "Improvements in the manufacture of vinegar, and in the acidulation or treatment of various liquids, and in the apparatus employed therein."—A communication from R. D. Turner and J. Vanderpool, New York, U.S.A.—Dated June 24, 1872.

2046. E. P. H. Vaughan, F.C.S., Chancery Lane, Middlesex, "Improvements in the mode of utilising the waste gases of metallurgical and other furnaces."—A communication from F. Pernot, Paris.—Dated July 6, 1872.

2920. J. Saunders and J. Piper, Cookley Iron Works, near Kidderminster, "Improvements in coating tin and terne plates, and in apparatus employed therein."—Dated October 3, 1872.

MEETINGS FOR THE WEEK.

Monday, Dec. 23rd.—Medical, 8.
—— Society of Arts, 8. Cantor Lectures. Dr. C. Meymott Tidy.
Friday, 27th.—Quekett Club, 8.
Saturday, 28th.—Royal Institution. Professor Odling, M.A., F.R.S., "On Air and Water."

THE
QUARTERLY JOURNAL OF SCIENCE,
AND
ANNALS OF MINING, METALLURGY, ENGINEERING, INDUSTRIAL ARTS, MANUFACTURES, AND TECHNOLOGY.

Edited by WILLIAM CROOKES, F.R.S., &c.

No. XXXVII., *January*, 1873, price 5s.

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IV. A Solution of the Sewage Problem.
V. Colours and their Relations. By Mungo Ponton, F.R.S.E.
VI. Remarks upon the Present State of the Devonian Question. By Horace B. Woodward, F.G.S.

Notices of Books. Progress of the Various Sciences, &c., &c.

London: Offices of the Quarterly Journal of Science, 3, Horse-Shoe Court, Ludgate Hill, E.C.

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The CHEMICAL and TOXICOLOGICAL CLASS on Monday and Thursday evenings at 8 p.m., commencing October 1st.

The LATIN CLASS on Tuesdays and Fridays at 8 p.m., commencing October 2nd.

The MATERIA MEDICA and BOTANICAL CLASS, every Wednesday and Saturday at 8 p.m., commencing October 3rd.

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THE CHEMICAL NEWS.

VOL. XXVI. No. 683.

COLOURING-MATTERS DERIVED FROM AROMATIC AZODIAMINES.*

By A. W. HOFMANN, Ph.D., F.R.S., and A. GEYGER, Ph.D.

II. SAFRANINE.

WHILST we were engaged with the study of the blue colouring-matters produced by the action of aromatic monamines on azodiphenyldiamine, our attention became directed to a beautiful red tar-pigment, which has been known for some time by the commercial name of safranine, being extensively used as a substitute for safflower in dyeing silk and cotton. Safranine has not as yet been minutely examined; but, as far as can be judged from the scanty information we possess regarding its production, it is scarcely doubtful that this important dye must be looked upon as being the derivative of an azodiamine. The analyses of safranine thus promised to throw considerable light upon the nature of the compounds under examination.

The starting-point of our studies was the dye such as it occurs in commerce. The greater portion of it was supplied to us by Messrs. Tillmanns, in Cryfeld. Another specimen was received from Dr. T. Wolf, and for a third we are indebted to our friend M. Charles Girard, in Paris. Both the first-mentioned specimens were assigned to us as produced on the large scale; the last was prepared by M. Girard himself.

Safronine occurs in commerce either as a solid body or *en pate*. In the solid state it forms a yellowish-red powder, in which, together with considerable quantities of chalk and common salt, the chlorhydrate of a tinctorial base has been recognised. The pure dye may be easily separated from the crude safranine. It is only necessary to exhaust the commercial product with boiling water; on cooling, the filtrate deposits a slightly crystalline substance, which, after several re-crystallisations from boiling water, leaves no residue on ignition. During these operations, however, the salt undergoes perceptible alteration; with every re-crystallisation it becomes more soluble and less crystalline. These alterations depend upon the separation of chlorhydric acid from the salt. In fact the percentage of chlorine is found to diminish in the product of successive crystallisations; thus the product of the third contained 8·48 per cent, that of the fourth crystallisation only 7·46 per cent. Addition of chlorhydric acid to the mother-liquors at once reproduces a crystalline precipitate. This instability of the chlorhydrate, and in fact, as may even now be stated, of the salts of safranine in general, has very considerably impeded the study of this body, and often materially affected the accuracy of the analytical results. In order to obtain the normal salt, the boiling liquid during the last crystallisation had always to be acidified with chlorhydric acid.

Safranine chlorhydrate separates in fine reddish crystals from the acid solution on cooling; an appreciable quantity of the compound, however, remains in solution. The salt dissolves both in water and alcohol more readily when hot than when cold; it is insoluble in ether, as also in concentrated saline solutions. The alcoholic solution, like the aqueous, is of a deep red-yellow colour; it exhibits a peculiar fluorescence, which in a measure recalls that of Magdala-red. Ether precipitates the salt from the alcoholic solution. Numerous analyses which we have made of this salt lead to the following two formulæ:—

$$C_{20}H_{21}N_4Cl \quad \text{and} \quad C_{21}H_{21}N_4Cl,$$

the theoretical values of which agree almost equally well with the averages of the experimental numbers. We were doubtful at first to which of these two formulæ preference should be given. Indeed the assumption of twenty atoms of carbon in the molecule of safranine had its seductions; however, the values of the second formula agreed perhaps somewhat better with the results of analyses. Indeed we found invariably somewhat less nitrogen than the quantity required by the former formula, whilst it is well known that the volumetric method invariably gives an excess; so that we should have adopted the second formula, even if later experiments on the preparation of safranine had not altogether excluded the former one.

Platinum Salt of Safranine.—The numbers obtained in the analysis of the chlorhydrate are confirmed by the investigation of the platinum salt. This compound is obtained by precipitating a solution of the chlorhydrate by excess of platinum perchloride; dilute hydrochloric acid must be used to wash this precipitate, as pure water appears to decompose it. The platinum salt forms a yellowish-red crystalline powder, nearly insoluble in water, alcohol, and ether.

If the salt suspended in boiling water be treated with sulphhydric acid, sulphide of platinum is slowly formed, whilst unaltered chlorhyhrate of safranine remain in solution. The analysis of the salt, dried at 100°, gives numbers corresponding to the formula—

$$2(C_{21}H_{20}N_4HCl)PtCl_4.$$

Free Base.—In order to prepare some other salts of safranine it was necessary to obtain the free base. When we first commenced the study of this new compound, remembering the properties of the tinctorial ammonias in general, we endeavoured to precipitate the base from the chlorhydrate by alkalies. Ammonia, however, is without any action whatever over salts of safranine; and only in the most concentrated solutions does soda produce a precipitate, which immediately re-dissolves on addition of water. This precipitate is obviously nothing but chlorhydrate rendered insoluble by the sodium chloride formed, or by the concentrated soda solution. Free safranine being soluble in water, there remained no other process for liberating the base than treatment of the chlorhydrate with silver oxide. On evaporating the deep yellow-red coloured liquid obtained in this way a deposit of red-brown crystals is formed on cooling, which while moist scarcely differ from those of the chlorhydrate, but when dried at 100°, assume a greenish metallic lustre. Free safranine easily dissolves in water and alcohol, but is insoluble in ether. Addition of chlorhydric acid to the aqueous solution at once reproduces the crystalline chlorhydrate. We have not been fortunate enough to obtain free safranine in a state of perfect purity; the solution invariably retains a small quantity of silver chloride, which separates with the crystallising product; it may be recognised by burning the base, when a small incombustible residue is left. If the chlorhydrate be reproduced from the free base, so much silver chloride is mixed with the salt, that the percentage of chlorine, found on analysis, is appreciably raised. An estimation of chlorine in the chlorhydrate thus prepared gave 10·8 per cent, instead of 9·74. Free safranine, however, may be used without difficulty in the preparation of other salts, the nitrate for instance.

Safranine nitrate is easily obtained when an excess of dilute nitric acid is added to a hot aqueous solution of the free base. On cooling the salt crystallises in red-brown needles, which are very insoluble in cold but readily dissolve in boiling water. They are considerably more soluble in alcohol than in water. The nitrate is decidedly less soluble than the chlorhydrate; a solution from which the latter salt has been thrown down by

* A Paper read before the Royal Society.

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chlorhydric acid still gives a precipitate with nitric acid.

The analysis of the nitrate, dried at 100°, leads to the formula $C_{21}H_{21}N_5O_3 = C_{21}H_{20}N_4.HNO_3$.

Safranine picrate.—We have finally investigated the picrate. It is obtained by simply adding an aqueous solution of picric acid to the mother-liquors of the chlorhydrate or nitrate, and washing the precipitate thus formed with water. The picrate forms red-brown needles, which are insoluble in water, alcohol, and ether.

The analysis gave results corresponding to those obtained in the investigation of the chlorhydrate of the platinum salt and of the nitrate, and leading to the formula $C_{27}H_{23}N_7O_7 = C_{21}H_{20}N_4.C_6H_3(NO_2)_3O$. We have no further analytical data to offer at present. A brief notice of several other salts we have prepared may, however, still be appended.

Safranine bromhydrate is deposited on addition of bromhydric acid to a solution of the base, as a crystalline powder, consisting of microscopic needles, which are so insoluble in water that the liquid from which they have been precipitated appears almost colourless. The salt is soluble in boiling water, from which it crystallises on cooling. It is worth mentioning that, on adding bromine water to a solution of the chlorhydrate, a red crystalline precipitate is formed, which is difficultly soluble in cold water, but may re-crystallise from boiling water. In this way needle-shaped crystals are obtained which, when pure, possess a green metallic lustre. They have not yet been analysed.

The *iodhydrate*, as regards preparation and properties, is perfectly similar to the bromhydrate.

The *sulphate of safranine* is a tolerably soluble salt: only in the most concentrated aqueous solution of the base is a precipitate produced on addition of dilute sulphuric acid; the salt dissolves on heating the liquid, and is again deposited on cooling in the form of fine needles.

The *oxalate* behaves very similarly, but is a little less soluble than the sulphate; with acetic acid the base gives no precipitate; by spontaneous evaporation the acetate separates in rather indistinct crystals.

All the salts of safranine exhibited very characteristic reaction; on adding chlorhydric acid to the solution of the salt, the red-brown colour of the liquid changes to a beautiful violet, which, on addition of more acid, becomes a deep blue, then a dark green, and finally bright green; if the acid liquid be slowly diluted with water, these changes of colour may be observed in inverse order.

It need scarcely be mentioned that in the course of this investigation our attention has been repeatedly directed towards the preparation of safranine; it may, however, at once be stated that our experiments on this subject have yielded but scanty results. As yet but little is known regarding the preparation of safranine on a large scale. According to a brief notice published by Mené*, safranine is obtained by treating aniline successively with nitrous and arsenic acids; this process very closely agrees with the method by which M. Girard, as he informs us, has prepared the specimen transmitted to us. We have, moreover, to thank M. Girard for pointing out that aniline of a very high boiling-point is especially adapted to the preparation of safranine.

After some practice we have been able, by working according to these indications, to obtain safranine with all the properties of the commercial product. The yield, however, was always very small, an exceedingly large quantity of little attractive by-products being invariably formed. Somewhat more satisfactory results were obtained when chromic instead of arsenic acid was used as oxidising agent. Our experiments, though unsuccessful as regards the discovery of a good method for preparing safranine, they nevertheless appear to supply some welcome indications as to the real source of the colouring-matter. Neither from pure aniline nor from solid toluidine have we been able to obtain safranine by the above-mentioned process; nor did a mixture of pure aniline on the solid toluidine yield a better result. We have, however, invariably obtained safranine when liquid toluidine, boiling at 198°, was used for the experiment. This colouring-matter thus appears to become a pure derivative of toluidine, and the formula $C_{21}H_{20}N_4$, to which analyses had led, is corroborated, as far, at all events, as the number of carbon atoms in the molecule of safranine are concerned, in a most satisfactory manner by the formation of this body. In this formation, as in that of rosaniline and of the allied tinctorial ammonias, 3 mols. of monamine associate to a complex molecule, 3 atoms of hydrogen in which are displaced by one of nitrogen, and 4 atoms of hydrogen being, moreover, removed by oxidation.

$$3C_7H_9N + HNO_2 = C_{21}H_{24}N_4 + 2H_2O.$$
$$C_{21}H_{24}N_4 + 2O = C_{21}H_{20}N_4 + 2H_2O.$$

A glance at the safranine formula with its four nitrogen atoms recalls the composition which Mr. Perkin ascribes to mauveine.

Safranine .. .. $C_{21}H_{20}N_4$.
Mauveine .. .. $C_{27}H_{24}N_4$.

The idea suggests itself that mauveine might be phenyl-safranine, $C_{27}H_{24}N_4 = C_{21}H_{19}(C_6H_5)N_4$. In fact safranine salts yield a violet colouring-matter when boiled for some time with aniline; again, safranine and mauveine exhibit nearly the same changes of colour under the influence of concentrated acids. Further, from a short notice published some years ago by Mr. Perkin,* safranine appears to be a by-product in the preparation of mauveine.

Relations such as suggested by the above formulæ must, however, be received with great caution. The violet colouring-matter derived from safranine has, by phenylation, not as yet been further characterised. No great stress can be laid on the similar colour reactions, with acids, exhibited by both bases; since the methylate rosaniline, on treatment with acids, also becomes first blue and then green. Moreover, it is doubtful whether the base obtained by Mr. Perkin as a secondary product in the manufacture of mauveine really is the same safranine which we have investigated, inasmuch as some preliminary analyses have led him to a very different composition, which appears to be expressed by the formula $C_{18}H_{18}N_4$. Finally, the composition of mauveine itself cannot be looked upon as established above all question; at least Mr. Perkin† seems still to hesitate between the formula $C_{26}H_{24}N_4$, which appears to result from more recent experiments, and the formula $C_{27}H_{24}N_4$, previously announced by him.

The relations here pointed out are, however, well worthy of a thorough experimental investigation. As we intend to continue this inquiry, an opportunity may present itself for their further elucidation.

* *Mené*, from the *Revue Hebd. Chim. Scient. Indust.*, Feb. 29, *1872, in* CHEMICAL NEWS, vol. xxv., p. 215.

* Perkin, *Proc. R. Inst. of Great Britain*, vol. v., p. 572.
† Perkin, *loc. cit.*

INDUSTRIAL MANUFACTURE OF CHLORINE.

By F. de LALANDE and M. PRUD'HOMME.

THE reaction of anhydrous sulphuric acid mixed with air or oxygen upon heated alkaline chlorides, which has given rise to Deacon's patent for the preparation of chlorine and of sulphate of soda, has led us to generalise this process. We have chiefly experimented with silicic, boric, stannic, and phosphoric acids, and also with alumina. When any of these bodies, silica, for instance, is mixed with an alkaline chloride, or with an alkaline-earthy or earthy chloride, and over this mixture, while being heated to red heat, a current of dry oxygen or air is passed, chlorine is evolved, and a silicate formed of the base of the chloride

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employed, $SiO_2 + ClNa + O = SiO_2NaO + Cl$. At red heat, therefore, oxygen expels chlorine, when there is simultaneously present an acid capable of uniting with the base which is formed. Chlorides heated *by themselves* in a current of oxygen (chloride of calcium, for instance) do not give off chlorine. When a current of *hydrochloric acid* gas is passed along with oxygen over the mixture of silica and chloride the acid regenerates the chloride and decomposes the silicate—

$$SiO_2NaO + HCl = SiO_2NaCl + HO.$$

In this way a *continuous* evolution of chlorine is obtained. Instead of taking the mixture of chlorine and silica, the silicate of the metal in which the chloride is contained, or a mixture of silica and the oxide of that metal is taken. Since analogous reactions occur with the acids above mentioned, we may state that it is general. The steam formed during the phase of reaction—

$$SiO_2NaO + HCl = SiO_2 + NaO + ClO$$

gives rises to two secondary actions:—

(1). The chlorine decomposes the water at red heat:—

$$HO + Cl = HCl + O.$$

(2). The steam decomposes the chlorides at red heat:—

$$NaCl + HO = NaO + HCl.$$

It is probable that under these conditions an equilibrium exists between the quantities of chlorine, aqueous vapour, and hydrochloric acid issuing from the apparatus, or a limit of maximum between the quantity of chlorine produced and the hydrochloric acid evolved and issuing from the apparatus. This limit of maximum will be the greater according as the temperature required for the reaction be less high. Some of our experiments having been made by causing the substances operated with to be imbibed by pumice-stone, we have been induced to try whether pumice-stone alone would yield any result, that material being a complex silicate and a substance belonging to the category of those indicated by us. We have found that with pumice-stone an evolution of chlorine is obtained comparable to that obtained from the other substances, more particularly silica and lime, boric acid and lime, stannic acid and lime, alumina and chloride of sodium; since the same result is obtained with lumps of brick, it might be ascribed to the porosity of these substances; but this opinion is gainsayed by the fact that under the same conditions pipe-clay, a silicate of alumina and a very porous body, does not give rise to any appreciable reaction; it therefore appears possible that hydrochloric acid converts the surface of pumice-stone into a mixture of silica and chlorides. We have compared the production of chlorine in our experiments with that obtained by using bricks impregnated with sulphate of copper (Deacon's patent); the quantity of chlorine obtained in both cases is the same; but with bricks impregnated with sulphate of copper the reaction takes place at a lower temperature. The imperfection of our apparatus has hitherto prevented us from estimating the respective quantities of chlorine, hydrochloric acid, aqueous vapour, contained in the gases issuing from the apparatus; neither have we been able to estimate exactly the degree of temperature at which the reactions take place.

MINERALOGY.

MR. W. W. SMYTH, F.R.S., took for the subject of his fifth lecture of the course to working men, delivered on Monday, December 9th, "Carbon and Coals."

The substances of which he proposed to speak were all characterised by consisting wholly or principally of carbon, although differing very much in their outward forms. The diamond is a crystallised form of pure carbon, remarkable from the earliest times for its great brilliancy and extraordinary hardness. Its hardness is so great as to render it capable of cutting or scratching all other substances; and this character has lately been taken advantage of in a very ingenious application of the diamond to boring or drilling holes through hard rock masses. For this purpose a number of pieces of diamond—of course of the inferior qualities—are set in a ring round the end of a tube, and it is found that by this means very rapid progress can be made, compared with that accomplished by the use of steel tools alone. The simplest crystalline form assumed by the diamond is that of octahedron, very frequently with the edges a little worn and rounded; and the more complicated crystals are all capable of being split parallel to the faces of the octahedron. This property of splitting is taken advantage of to obtain fragments with sharp edges for cutting purposes. The great brilliancy of the diamond is due entirely to the very great refractive power; on account of which, many of the rays of light falling upon a piece of diamond are so much refracted as to be reflected from the interior, and when the diamond is cut into suitable facets, the brilliancy is so great as to have obtained for the form the name of "brilliant." The origin of the diamond is not yet cleared up. It is found in the detrital matter brought down by streams in parts of Brazil, India, and the Cape of Good Hope.

Graphite (from *grapho* to write) is a substance exactly like diamond in its chemical composition, but very different in outward appearance and its crystalline form. The latter is very distinct, being chiefly that of minute hexagonal scales, the minuteness and incoherence of which render it usually so soft, and also enable it to be employed as an anti-frictional material. Thus we have two substances formed of the same material carbon, but at opposite extremities of the scale of hardness. Varieties of it are found containing from 90 to 95 per cent of carbon; the remainder is impurity in the shape of iron oxide, &c. It is now, especially in some parts of Central Europe, in great request for the manufacture of crucibles, in consequence of its great degree of infusibility. The purest kinds of it are not, as people used to believe, confined to Borrowdale in Cumberland; enormous quantities are now raised and imported from Ceylon, Canada, Bavaria, Bohemia, &c.

In coals,—which taken on the large scale are far more important to us than the diamond—the carbon loses its distinct crystalline state, and is mixed more or less with other materials. The lecturer then briefly explained the manner in which the coal occurs, viz., in bands or layers, technically known as "coal-seams" of various thicknesses, alternating with other strata of indurated clay, known as shale, and of grey sand-stone, called grit. At the base of each bed of coal is found a bed of clay, which contains the fossil roots of the plants from which the coal has been formed. The beds are not in all cases horizontal, though originally deposited so, but have been tilted up into various positions. They vary, too, a great deal in thickness, being in some cases too thin to be profitably worked, *i.e.*, under present conditions. The following list gives the number of workable seams, and the average total thickness of them in several localities for purposes of comparison. South Wales, 57 seams, 179 feet thick: North Staffordshire, 62 seams, 165 feet; Derbyshire, 40 seams, 86 feet; Newcastle, 16 seams, 50 feet; Westphalia, 83 seams, 173 feet; Saarbruck, 164 seams, 338 feet. It will be seen that the supply to the Newcastle field is strictly limited; the adjoining Durham coal-field has lately been proved beneath the sea.

On examining a lump of coal, it may be frequently be observed to be made up of a series of parallel laminæ, sometimes as many as 20 to an inch. Sometimes these layers are alternately bright and dull, and are really two distinct varieties of coal, one burning with far more flame and smoke than the other. These laminæ are, or have been, more or less horizontal, but in some districts there is also a set of parallel divisional planes running in a direction at right angles to the first set of laminæ. These are of great value and importance to the miner in getting the coal, for

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by taking advantage of these planes he can obtain a larger proportion of large coal than if he has to break down irregular lumps with his pick. Occasionally, a third set of parallel lines occurs at right angles to the last set, and then the coal breaks into more or less cuboidal or rhomboidal blocks with smooth faces.

If we classify coals according to their proportions of carbon, which is the heat-giving element, and therefore the measure of their quality as fuel, we have first anthracite or stone coal, with 90 to 98 per cent of carbon, worked amongst other places in the west part of the South Wales coal field. It is rather difficult to light, but makes extremely hot fires when fairly set going. Next come the steam, smokeless, or free burning coals, worked round Merthyr-Tydvil and Aberdare, which are highly valued for steamers, and especially for men-of-war. Then comes a great series of coals such as are found in the Midland Counties, and supplied to most parts for household purposes. These are more or less bituminous, burning with a greater quantity of flame and smoke than either of the two preceding varieties. Cannel coal does not soil the fingers, and is capable of taking a fair polish. It is worked in large quantities about Wigan in Lancashire. Lignite, or brown coal, is an intermediate state between true wood and true coal, having frequently a texture and appearance much like wood. It contains less carbon and more gaseous matters than true coal, and gives off a great deal of smoke. It occurs in Saxony, and Bohemia, &c., on the Continent; and on a small scale in England, at Bovey Tracey.

Errata.—P. 297, col. 2, line 9 from bottom, for *bars* read *arches*. P. 298, col. 2, line 36 from top, for *Aduli* read *Adula*. Line 38, for $\dddot{Al}\,\dddot{Si}_3 + \dot{K}\,\dddot{Si}$ read $\dddot{Al}\,\dddot{Si}^3 + \dot{K}\,\dddot{Si}^3$. Line 15 from bottom, for Ca_3Si read Ca_3Si_2. Line 5 from bottom, for *streets* read *villages*. P. 299, line 19 from top, for $12\dddot{Al}\,\dddot{Si} + (2AlF_3 + 3SiF_2)$ read $6\dddot{Al}\,\ddot{Si} + (AlF_3 + SiF_2)$. Line 28, for $\dddot{Al}\,\dddot{Si} + Be\,Si$ read $\dddot{Al}\,\ddot{Si}_3 + \ddot{Be}\,\ddot{Si}_3$.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, December 19th, 1872.

Prof. WILLIAMSON, F.R.S., Vice-President, in the Chair.

AFTER the minutes of the previous meeting had been read, Messrs. E. M. Prevost, Ph.D. and F. H. Hobler were formally admitted Fellows of the Society.

A list of the Donations made to the Society then followed, and the names of Messrs. Charles Lees, John Abigal Bower, Miles H. Smith, George Frederick Schacht, Alfred J. Cownley, and Walter E. Koch were read for the first time; for the third time, Messrs. Alfred Payne, George Combe Stewart, Robert Routledge, D.Sc., and George B. Beilby, who were then balloted for and duly elected.

The first paper entitled "*Analysis of Water of the River Mahanuddy*," by E. NICHOLSON, was read by the SECRETARY. The author first details the method he pursued in order to clarify waters which remain turbid even after standing for a long time, and also for determining the amount of suspended silt. This he effects by the addition of ammonium sulphate to the water, and subsequent concentration whereby the silt separates in flocks which are capable of being collected on the filter. He then proceeds to describe the position of the Mahanuddy river, its course, and the geological structure of its bed, &c.; and gives the results of his analyses of the water, from which he finds that it contains less dissolved matter than *any other river* in India; the total amount of mineral solids being 0·12 grm. per litre, of which 0·0343 grm. was suspended silt. The hardness of the water by the soap-test was 5° of the centigrade scale.

Dr. WILLIAMSON said that, from the author's experiments, this water appeared to offer some points of difference from ordinary waters, especially the difficulty of separating the suspended matter. With regard to the process he adopts of treatment with ammonic sulphate, it was a question how far it might alter the composition of the constituents of the water.

Mr. WARINGTON remarked that in the case of flood-water passing over a clayey soil, and which was very difficult to clear, it had been found that all salts, and especially calcium salts, caused a coagulation of the suspended matter, which greatly facilitated the subsidence of the silt and filtration of the water.

Mr. THORPE said that he could corroborate Mr. Warington's remarks. He had recently examined a turbid water which passed, apparently unaltered, through four thicknesses of Swedish filter-paper, but after treatment with sulphurous anhydride it became capable of being filtered. The difficulty in introducing such substances as precipitants was, that they are liable to take down other constituents of the water besides the suspended matter. He had found loam to be preferable to sand for filtering water.

In reply to a question of Dr. Warren de la Rue, Mr. THORPE further stated that he had frequently examined silts from flood-waters microscopically, but had never been able to detect any traces of organic life.

The CHAIRMAN observed that the use of sulphate of alumina to assist the clarification of waters in which the organic constituents were to be determined, as practised by the author, was highly improper; it was almost certain that a change would be produced. The same might be said of the effect of calcium chloride in waters containing acid silicates, some of the silica must be taken down. For his own part, he thought the most satisfactory plan was to allow the water time to settle.

The second paper "*Researches on the Polymerides of Morphine and their Derivatives*," by E. Ludwig Mayer and C. R. A. Wright, D.Sc., was read by Dr. WRIGHT, and illustrated with specimens of many of the substances mentioned. The memoir consisted of several papers, the first being on the action of zinc chloride on morphine. At low temperatures, and with concentrated solutions of the zinc salt, tetrapo-dimorphine (apo-morphine) appears to be the principal product, but at higher temperatures and with the addition of strong hydrochloric acid a "tetra" polymeride of apo-morphine is formed, which may be called octapo-tetramorphine. The principal results enumerated in the second paper, "On the Action of Hydrochloric Acid on Morphine," are that besides apo-morphine mixtures of three bases are produced which may be written $M + 3HCl$, $M + 3HCl - H_2O$ and $M_4HCl - 2H_2O$, where M stands for morphine, $C_{34}H_{38}N_2O_6$. The action of sulphuric on morphine appears generally to yield polymerides without abstraction of water, the principal products being the sulphates of trimorphine, $C_{102}H_{114}N_6O_{18}$, and tetra-morphine, $C_{136}H_{152}N_8O_{24}$. The authors also describe the results of the action of hydrochloric acid on trimorphine and tetra-morphine and state the physiological action of the various bases, concluding with a table of the names, formulæ, &c., of no less than nineteen derivatives of morphia.

The CHAIRMAN in thanking the authors for laying before them the results of their elaborate researches, alluded to the wide field which they embraced, offering various interesting points for discussion.

Mr. PROSJEAN remarked that the subject was certainly a large one, and already sufficiently bewildering, so that he must protest against the use of some of the names which the authors had employed, more especially the introduction of prepositions into them. Some of the old names were certainly unwieldly enough, but he preferred them to such terms as apomorphine, in which there was nothing

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to signify that it was derived from morphia by the abstraction of water. It might equally mean that anything else was taken away.

Dr. WRIGHT replied that the title was first employed by the late Dr. Matthiessen to signify that the substance was a derivative from morphia, and that it had now become a conventional term to signify the abstraction of water, and was certainly less a misnomer than such names as oxygen.

Mr. VERNON HARCOURT certainly thought that there was no reason for the introduction of prepositions into chemical names without any consideration of the fitness of the term. The prefix "apo" certainly gave no indication that the substance was a derivative formed by the abstraction of water.

Dr. H. E. ARMSTRONG then brought forward "Communications from the Laboratory of the London Institution, Nos. VIII.—X." In the first of these, entitled "*Derivatives of β-dinitrophenol*," he describes the monoiodo-, chloro-, and bromo-derivatives of β-dinitrophenol, a compound produced, along with α-dinitrophenol, when the volatile modification of mononitrophenol is acted upon by nitric acid. The new compounds were prepared by the direct action of the corresponding halogen on the β-dinitrophenol. Iodo-β-dinitrophenol, obtained by the action of iodine and mercuric oxide on β-dinitrophenol, crystallises in bright yellow needles, which melt at 113°. The potassium derivative forms brilliant red flat needles, which exhibit a marked dichroism, the reflected light being metallic green in one direction, yellow in another. The corresponding bromo-β-dinitrophenol melts at 116°, and yields a yellowish brown potassium derivative.

In the second communication, "*Note on the Action of Bromine in presence of Iodine on Trinitrophenol (Picric Acid)*," the author first alludes to Dr. Stenhouse's experiments on the action of bromine on picric acid, and to his later experiments on the action of chlorine on picric acid in the presence of iodine, which yielded a chloro-dinitrophenol, and then states that he had also succeeded in isolating the first product of the action of bromine on picric acid, viz., bromo-dinitrophenol. The chloro-dinitrophenol obtained by Stenhouse is isomeric with the body formed by chlorinating α-dinitrophenol; hence it might have been expected that the corresponding bromo-derivatives would also be isomeric. The author finds that there is a very close resemblance between the bodies from the two sources, even if they be not actually identical; this, however, cannot be satisfactorily settled until the product from trinitrophenol has been obtained in a pure state.

A "*Preliminary Notice on Iodo-Nitrophenols*" then followed. The author has commenced the examination of these bodies in order to ascertain whether any definite relation exists between the melting-points of the iodo-, bromo-, and chloro-nitrophenols. In order to prepare these compounds, the nitrophenols, in alcoholic solution, were acted on by iodine and mercuric oxide. The iodo-dinitrophenol, from α-dinitrophenol, was found to melt at 105°, Körner giving 114° as its melting-point. The action of iodine on ortho-nitrophenol was found to give rise to the formation of diiodo-nitrophenol, melting at 155·5°, even when the quantity of iodine employed was only sufficient to form the monoiodo-derivative, nitrophenol remaining unacted on, a result similar to that obtained when acting on an alcoholic solution of phenol-parasulphonic acid by iodine and mercuric oxide, a diiodo-phenol-sulphonic acid being formed. In like manner, chlorine and bromine, when acting upon the same acid, give rise to the formation of di-substitution products. The author has also prepared the mono- and diiodo-derivatives of the volatile modification of nitrophenol.

The CHAIRMAN thanked the author, in the name of the Fellows, for his interesting communication and for the series of beautiful specimens with which he had illustrated it.

In reply to a question put by Dr. Wright, as to the iodine substitution-compound having a lower melting-point than the chlorinated derivative, whilst the brominated one was higher, Dr. ARMSTRONG remarked that the relation of the fusing-points depended entirely on the series to which the substance belonged, and instanced several cases in which different relations subsisted between various haloid derivatives.

The last paper, a preliminary notice "*On the Formation of Naphthaquinone by the Direct Oxidation of Napthalene*," by CHARLES E. GROVES, was read by the author, in which, after drawing attention to the fact that naphthaquinone itself had not yet been carefully examined, he described the method of preparing it by the action of chromic anhydride on naphthaline in solution in glacial acetic acid. The naphthaquinone is a crystalline body of a fine yellow colour, which, when boiled with strong hydriodic acid and phosphorus, takes up a molecule of hydrogen and becomes converted into hydro-naphthaquinone, a colourless substance crystallising in needles. When equal molecular weights of the quinone and the hydroquinone are boiled together in aqueous solution, an intermediate quinone, of a dark purple colour, is formed, corresponding to the green hydroquinone of the benzol series. The same substance is produced by the action of weak hydriodic acid on naphthaquinone.

Dr. ARMSTRONG remarked that it would be very interesting to try the action of chromic anhydride in a similar manner on the chlorinated derivatives of naphthalene, in order to ascertain whether they would yield quinones or split up with formation of phthalic acid.

The CHAIRMAN, after returning thanks to the author for his interesting communication, stated that the next meeting would take place on Thursday, January 16th, when papers would be read "On Several Vanadates of Thallium," by T. Carnelly; "On Heptanes from Petroleum," by C. Schorlemmer; and "On Ethylamyl," by Mr. Grimshaw.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, November 26th, 1872.

J.P. JOULE, D.C.L., LL.D., F.R.S., &c., President, in the Chair.

Dr. R. ANGUS SMITH, F.R.S., said that he, like others, had observed that the particles of stone most liable to be in long contact with rain from town atmospheres, in England at least, were most subject to decay. Believing the acid to be the cause, he supposed that the endurance of a siliceous stone might be somewhat measured by measuring its resistance to acids. He proposed, therefore, to use stronger solutions, and thus to approach to the action of long periods of time. He tried a few specimens in this way, and with most promising results. Pieces of about an inch cube were broken by the fall of a hammer, and the number of blows counted. Similar pieces were steeped in weak acid; both sulphuric and muriatic acids were tried, and the latter preferred. The number of blows now necessary was counted. Some sandstones gave way at once and crumbled into sand; some resisted long. Some very dense siliceous stone was little affected; it had stood on a bridge unaltered for centuries, in a country place, however. These trials were mere beginnings; he arranged for a very extensive set of experiments to be made, so as to fix on a standard of comparison, but has not found time.

"*On some Points in the Chemistry of Acid Manufacture*," by H. A. SMITH, F.C.S.

The author endeavours to throw some light on th interior economy of the lead chamber as at present used in the manufacture of sulphuric acid, by making first:—

An Experimental Examination of the Causes which Determine the Action, inter se, of the Gases in the Lead

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Chamber.—The conclusion come to differed from that generally received. He believes that action can take place between dry sulphurous acid and nitric acid gases, without the use of steam, and showed by several experiments that, if action be commenced between the abovementioned gases, it continues, even in the absence of air, till all the available oxygen present in the nitric acid has been made use of.

He also comes to the following conclusions:—

1. That the volume of steam introduced should be less than the combined volumes of the two gases.
2. That the volume of steam introduced should increase in proportion to the increase of temperature.
3. That the greatest amount of action between the two gases (and therefore the greatest yield of vitriol) takes place near the surface of previously-formed sulphuric acid, and that therefore in "starting" the working of a chamber sulphuric acid should be run upon the bottom in preference to water, as at present generally done.
4. That the upper part of the chamber is of use principally as a "reservoir," and that little or no action takes place between the gases at that part.

The next point claiming attention was:—

The Distribution of the Gases in the Lead Chamber.—The following tables will show the results arrived at:—

SULPHUROUS ACID.—TABLE I.

Length of Chamber in feet.	10	20	30	40	50	60	70	80	90	100	110	120	130	140	Length of Chamber in feet.
No. 2. ft. in height, 15 (Entrance.)	72%	70 to 72%	46%	31 to 33%	25%	26%	30%	22%	29 to 30%	22%	23%	13%	18%	18%	15 feet in height. (Exit.)
No. 1. ft. in height, 3 (Entrance.)	3%	8%	16%	29%	28%	18%	19%	20%	17%	17%	14%	13%	8%	16%	3 ft. in height. (Exit.)
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	

Length of Chamber in feet.

No. 1 represents the percentage of acid at 3 feet from bottom of chamber.
No. 2 " " 15 " "

SULPHURIC ACID.—TABLE II.

Length of Chamber in feet.	10	20	30	40	50	60	70	80	90	100	110	120	130	140	Length of Chamber in feet.
No. 2. ft. in height, 15 (Entrance.)	0%	0%	6%	18%	23%	20%	18%	16%	19%	12%	12%	7%	7%	10%	15 ft. in height. (Exit.)
No. 1. ft. in height, 3 (Entrance.)	81%	89%	76%	70%	68%	67%	60%	56%	48%	30%	38%	30%	36%	33%	3 ft. in height. (Exit.)
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	

Length of Chamber in feet.

No. 1 represents the percentage of acid at 3 feet from bottom of chamber.
No. 2 " " 15 " "

NITRIC ACID.—TABLE III.

Length of Chamber in feet.	10	20	30	40	50	60	70	80	90	100	110	120	130	140	Length of Chamber in feet.
No. 2. ft. in height, 15 (Entrance.)	25%	18%	13%	13%	8%	7%	14%	13 to 14%	16%	20%	7%	3%	6%	6%	15 ft. in height. (Exit.)
No. 1. ft. in height, 3 (Entrance.)	8%	3%	6%	4%	4%	12%	8%	17%	20%	26%	26%	15%	12%	3%	3 ft. in height. (Exit.)
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	

Length of Chamber in feet.

No. 1 represents the percentage of acid at 3 feet from bottom of chamber.
No. 2 " " 15 " "

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GLASGOW PHILOSOPHICAL SOCIETY.

(CHEMICAL SECTION).

Ordinary Meeting, December 9th, 1872.

DR. WALLACE, F.R.S.E., President, in the Chair.

"*The Volcanic Vapours of Mount Vesuvius.*" A paper by Mr. JAMES ANDERSON was read on this subject, giving an account of a visit to Vesuvius in the month of October, 1871. On approaching the mountain, thin white clouds were observed to issue from its side and top; they were persistent, and continued to float for a long time against the dark blue sky as far as the eye could follow them. It was, therefore, naturally inferred that these clouds were not steam or the vapour of water, otherwise they would have been dissolved in the dry, hot air which surrounded them in the same manner as the vapour issuing from the funnel of a locomotive.

Having accomplished about three-fourths of the ascent, the party arrived at the foot of the small cone which emitted one of the continuous clouds of vapour. From its crater the latest flow of lava was ejected, which took place a few months previously. Some of this lava was still fluid, flowing slowly under a solidified crust down the slopes of the mountain. On arriving at a precipice it trickled over and became visible, forming fiery streaks. This small cone which projected from the side of the mountain would not be more than 50, or at most 60, feet high. Its sides were rather steep, particularly towards the summit, and a considerable effort was necessary to reach the mouth of the crater; which would not be more than 8 or 10 feet in diameter, and the boiling lava which emitted the vapours was only 15 or 20 feet distant from the party. The thin wall of lava on which they leant for support, and which was the only thing to prevent them slipping into the crater, was not more than 6 inches thick at the edge; but it was firm, being formed of the fused lava and scoriæ cemented together. The cloud of vapour generally filled the interior of the crater, and to the hand it felt hot and moist. Occasionally a gust of wind would blow the vapours to one side, and the red glare of the boiling-hot lava at the bottom could then be seen. Its vapours appeared white, somewhat dense, and, under the rays of the sun, had the granular or vesicular appearance of ordinary steam escaping into the atmosphere. The volume was not large, and just as it escaped from the summit of the cone it seemed to lose its vapourous appearance and to be resolved into a very thin white smoke, the surrounding dry hot air absorbing all the aqueous vapours. The walls of the crater were covered with a loose flocculent lining of a light gray colour, which adhered to the sides of the crater in the same manner as soot to the inside of a chimney, and had a depth of several inches. It seemed that this deposit was precipitated from the vapour as it ascended from the boiling lava below. Some of it was gathered close to the mouth of the crater, and an attempt was made to collect some as far down as the hand could reach, but it was too hot to be retained in the hand. Several hundredweights of this substance could have been gathered from the sides of the crater. A portion of this deposit was analysed by Mr. Michael Cochran, M.A., in the laboratory of the Glasgow University, and was found to contain per cent:—

Water	5·40
Silica	0·42
Oxide of copper	0·79
Peroxide of iron	15·43
Alumina	1·30
Oxide of manganese	0·07
Lime	0·28
Magnesia	0·32
Potash	22·04
Soda	14·10
Chlorine	4·58
Sulphuric anhydride	36·08
	100·81
Less oxygen equivalent to 4·58 Cl.	1·03
	99·78

The remarkable features of this analysis are the large proportions of potash, soda, iron, and sulphuric acid formed in the deposit, and the interesting inquiry suggests itself—"In what form did these substances exist in the molten lava? What gaseous compounds did they form when escaping from the red-hot lava? and how they would be affected on coming in contact with the atmosphere?"

Professor Phillips says that the composition of lava appears to be pretty uniform in all the periods of Vesuvian activity, and in one of the analyses quoted he gives the following as its composition:—

Silica	48·02
Lime	10·18
Alumina	20·78
Protoxide and peroxide of iron	7·97
Magnesia	1·16
Soda	3·65
Potassa	7·12
Sulphuric acid	trace
Chloride of sodium	trace
Water	trace

The guide accompanying the party imbedded a coin in the semi-fluid lava that was flowing down the side of the mountain. As the lava cooled, the coin became fixed in it. One of the party, Mr. H. J. Smith, a member of this Society, made a rough estimate of the potash, soda, and iron contained in the lava that adhered to the coin, and found the quantities of these substances to be fully as much as are given by Professor Phillips. The potash and soda exist in the state of silicates or aluminates, both of which are extremely fixed, even at very high temperatures. But in the presence of other gases a portion of the alkalies may be volatilised and separated from the silica and alumina. A very large quantity of steam is known to escape from the craters of active volcanoes. This steam would leave the lava at a very high temperature, and facilitate the escape of more or less of its volatile substances. It is well known that the presence of a gas in a liquid greatly facilitates the conversion of the liquid into vapour. Water does not of its own accord boil until it is raised to a temperature of 212° F.; but a cubic foot of air passed through it at a temperature several degrees below the boiling-point, will carry a cubic foot of steam along with it, and if alcohol, vinegar, hydrochloric acid, or other volatile liquids be mixed with the water, each would be carried off in proportion to its volatility. Glass is a species of lava containing a much larger proportion of potash or soda than natural lava. The glass maker has to protect his fused material from the hot gases of his furnace, to prevent them carrying off the potash and soda in the glass as vapour. When a piece of soft glass is kept fused for some time in the flame of a blowpipe, so much of the alkali is quickly carried away by the gases of the flame as to render the glass almost infusible. In the same manner, the steam and other gases passing through the red-hot molten lava may be expected to carry potash, soda, and other volatile substances along with them, these substances being again precipitated from the gases as they are cooled on the sides of the crater.

There is some difficulty in forming a satisfactory opinion as to where the water which forms the steam escaping from volcanoes comes from. But suppose the crust of the earth between the lava and the water of the sea to crack, and the water to rush in at the fissure, the moment it touched the hot lava it would be converted into steam, and unless the pressure be enormous the steam

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formed would force the water back again. Should this action really take place, it seems sufficiently powerful to account in a great measure for the sea waves and earthquakes that accompany volcanic eruptions, and may even contribute largely to the eruption itself. A column of water having the diameter of the vent of Vesuvius and half the height of the mountain, would contain 30 to 40 million tons of water. Assuming this vast body of water to be urged from the vent into the sea with all the force that red-hot water, forming into steam, can impart to it, the rush would be powerful enough to generate a wave having inertia sufficient to carry itself so far inland as to submerge cities and leave the shipping of seaports high and dry on the land. Those who are in the habit of sailing in some of the Clyde steamers are familiar with the noise that accompanies the escape of steam into cold water when the vessel stops for passengers at the piers. Sometimes the thuds caused by the sudden condensation are so strong as to make the boat tremble. Only a very small quantity of steam is required to occasion each of these thumps as they are produced, at the rate of hundreds if not thousands per minute. If the end of the pipe that dips into the water were visible, it would be seen that the water rushes in and out with the rapidity of a weaver's shuttle, a shock being produced every time the water is drawn in and driven out. The cold water entering condenses the steam as it advances, until the water next it becomes so hot as to be unable to condense any more. The steam then forces the water out of the pipe, and as soon as the steam again comes in contact with the cold water, the same process is repeated. Now the steam that produced the wave would come in contact with the cold water of the sea. The moment it did so, it would begin to condense, forming a vacuum into which the sea-water would again rush, and, urged on by its own weight and the weight of the atmosphere, fly back towards the red-hot lava, and he lava towards it, with a force resembling the meeting of two railway trains multiplied a thousand or a million-fold. Should such an encounter take place, the sudden pressure resulting from the impact of such enormous masses at the point of junction would be sufficiently powerful to make the earth tremble.

It is difficult to conceive of conditions by which the water would force itself in amongst the fused lava, penetrating so far as to permit the steam formed to boil up through the lava at the top of the mountain. If some such conditions as exist in the Giffard injector were realised, then the water injected would become steam and produce all the effects required for an eruption. There is another way in which a quantity of water may find its way quietly into the lava. Some rocks and minerals, such as chlorite, schists, gypsum, zeolite, &c., contain a considerable quantity of water (not as water is contained in a sponge), but in chemical combination, as is the case in soda crystals. Supposing a current of lava to come in contact with such rocks, and that the temperature of the lava is sufficiently high to fuse these hydrated rocks, the water will either be relieved as a gas or steam, or retained in combination. Assuming the melting of the hydrated rocks to take place at a considerable depth, notwithstanding the very high temperature, there are several reasons for concluding that the water would fuse with the rocks, and form part of the liquid lava. First of all, the pressure may be enormous. Supposing the hydrated rock to be not lower than the base of the mountain, the pressure on it would be equal to 4000 feet of lava. A block of lava 1 foot long, having a cross section of 1 square inch area, would weigh about a pound, making the pressure on a square inch 4000 lbs., equal to 266 atmospheres. It is said that water can be made red-hot under a high pressure without being converted into steam; while it is well known that carbonic anhydride, hydrochloric acid, ammonia, and other gases can be reduced to the liquid form under high pressures, the condensation being greatly facilitated by the presence of a liquid. Under the *ordinary pressure of* the atmosphere, water converts many gases into the liquid form, and the greater the pressure, the greater the quantity of gases absorbed and liquefied. There are certain facts that lead to the conclusion that very moderate pressures are sufficient to retain many gases in the liquid form, even at high temperatures, when other substances are present. Thus when oxide of silver is heated to redness it loses oxygen and becomes pure silver. But if the heat be continued until the silver melts, oxygen is re-absorbed from the air until twenty to thirty times the volume of the silver is absorbed. When the fused silver is allowed to cool, the oxygen boils out of it before it becomes solid. Here we have the same relation subsisting between fused silver and oxygen as subsists between carbonic acid and water. Before freezing, water parts with its carbonic acid gas in the same manner as silver parts with its oxygen. Seeing that silver absorbs and liquefies twenty to thirty times its own volume of oxygen under the pressure of the atmosphere, how much would it absorb and liquefy under the assumed pressure of 266 atmospheres? Ironfounders are very much annoyed by the tendency which iron has to absorb gases when fluid hot, and giving it out again while cooling; and they are put to some trouble to provide for its escape in such a manner as not to injure their castings. A head of metal is formed on the mould through which the gases escape, which supplies metal to the space occupied by the gases. The head is found to be in a frothy or spongy state, something like a piece of porous slag or lava. These small gaseous bubbles or cells are found to weaken the iron very much, and Whitworth's latest improvement in gunnery is the prevention of the formation of these cells by cooling the metal under a very great pressure. The gases are thus prevented from expanding, and are retained in chemical combination with the iron. In this manner, Sir Joseph Whitworth obtains a metal strong enough to enable him to make a gun capable of sending a shot or shell 7 to 8 miles. But it is not with fused metals only that gases have a tendency to combine at high temperatures. Slag from smelting furnaces absorbs and retains gases while hot, which are given out upon cooling. In the act of separating and expanding, the gases impart to the slag all the appearance of cellular lava. When carbonate of lime, such as chalk, or limestone is heated under pressure, the carbonic acid remains in combination with the lime and a fused carbonate of lime is obtained. If the pressure is removed before cooling, most of the carbonic acid assumes the gaseous form and escapes.

When oxide of lead, litharge, is heated until it fuses, it does not give out its oxygen as silver does, but absorbs more in the same way as melted silver; and what is more remarkable, when silver or litharge is heated with steam they combine with its oxygen and leave the hydrogen free. According to Deville, the oxygen is separated from the hydrogen by the heat before it combines with the silver or litharge.

The influence of heat under certain circumstances in separating chemically-combined substances into their elements is well known, while pressure has the opposite effect of causing chemical combination. In volcanic phenomena we have these two contending influences in great force, so great, indeed, that it is impossible by mere laboratory experiments to determine the result of their combined action. Judging from what we know, however, there seems to be room to conclude that at no very considerable depth the water, carbonic acid, and other gases escaping from volcanoes are in combination with the silica, alumina, lime, potash, soda, oxide of iron, and other substances which constitute the lava, and that they form one homogeneous fluid, in which all the ingredients are intimately mixed together. Such a lava moving obliquely or perpendicularly up the vent of a cone will experience a diminution of pressure as it ascends.

The more volatile substances will begin to assume the gaseous form, generating a mass of small cells which will expand a thousandfold as they ascend, converting the lava into a species of froth, from which the gases escape, or

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arriving at the crater, like steam out of a boiling-over pot, or the gases out of a soda-water bottle when the cork is removed. The steam and gases so escaping form the white cloud seen to issue from every active volcano. When the watery vapour is absorbed by the surrounding air, there remains the thin persistent cloud formed of substances similar to that found in the deposit, but in a sublimed state.

If water form a constituent of the fused lava under pressure in the manner suggested, it is easy to account for the cells of water found in the crystals of which granite is composed. If lava were permitted to cool slowly under the required pressure, the elements of which it is composed would elect to crystallise into felspar, mica, and quartz, the water separating and forming cells in the crystals. Should the lava in the volcanic vent be in the cellular or spongy state supposed, it will be very susceptible to variations in the atmospheric pressure. As the pressure increases the cells will become smaller, and as it diminishes they will expand, the body of the lava expanding with them and filling the crater sometimes to overflowing. This seems to be confirmed by observations made on Stromboli, one of the Lipari group of islands in the Mediterranean, a volcano which has been in moderate activity from the time of Homer.

Dr. Wollaston says, "the inhabitants of Stromboli positively make use of the volcano as a weather-glass. They are mostly fishermen, and while engaged in their occupation at a short distance from the island have its orifice constantly in view; and I was assured by all whom I questioned on the subject that its phenomena decidedly participate in the atmospheric changes, increasing in turbulence as the weather thickens, and returning to a state of comparative tranquillity with the serenity of the sky."

In the boiling of the vapours out of the lava, and their condensation on the sides of the crater, there is a process of distillation going on whereby the more volatile metals and their compounds are separated from the more fixed silica, alumina, and lime. In the continuous operation of volcanic action it may be asked, "How far does this distilling or volatilising action contribute to the formation of metallic veins?" Here we have the means whereby metals such as gold, silver, copper, zinc, and iron may be separated from masses of fused lava which may not contain a thousandth part of these metals. Professor Phillips mentions only a trace of copper in the lava, while Mr. Cochran found about 0·8 per cent of cupric oxide in the deposit. To what extent these volatilised metals may fill up cracks and fissures, and contribute to the formation of veins of metals, is a question for the mineralogist and the geologist. The crater of Mount Vultur, in the centre of Italy, has been a lake from the time of Horace, and gaseous exhalations still proceed from it. If the gases and vapours from the lava pass up through the water, the copper, iron, potash, soda, and other substances contained in the vapours will be taken up by the water, and certain chemical actions may take place that would precipitate the oxides of iron, copper, and other metals to the bottom of the lake.

Mr. MICHAEL COCHRAN, M.A., made some remarks upon the analysis referred to in Mr. Anderson's paper. He described one specimen which he had received as a grey amorphous salt, having the appearance of a finely-divided ash. In composition it differed much from ordinary lava, no less than 84·3 per cent being soluble in water, and 99·58 per cent soluble in strong HCl. The small quantity of silica present, and the large quantity of sulphuric anhydride, indicated that it had been formed by a process of sublimation. When ignited over the Bunsen flame it lost 10 per cent of its weight, 5·4 per cent being moisture, the remainder being sulphuric anhydride, from certain of the sulphates present, and also chloride of sodium. He regarded the following as representing the form in which the substances given in the above analysis were combined:—

Sulphate of potassium	(K_2SO_4) ..	40·80
,, sodium ..	(Na_2SO_4) ..	23·13
,, copper ..	($CuSO_4$) ..	1·59
,, aluminium	($Al_{23}SO_4$) ..	3·05
,, manganese	($MnSO_4$) ..	0·14
,, calcium ..	($CaSO_4$) ..	0·68
,, magnesium	($MgSO_4$) ..	0·96
Sulphuric acid	(H_2SO_4) ..	0·22
Chloride of sodium ..	(NaCl)	7·55
Ferric oxide	(Fe_2O_3) ..	15·43
Silicate of alumina ..	.. .. ..	0·78
Water	H_2O	5·40
		99·73

Of the above substances, manganous sulphate was the only one which he had not seen noticed by other writers as occurring in similar situations. The substance was not perfectly stable, the small quantity of free sulphuric acid present producing a slight chemical change. The sublimate gathered from the exterior of the cone by Mr. Anderson differed from the other somewhat in external aspect; one portion was of a yellow colour, the other blue, both having an irregular crystalline structure. As the quantity was small, the yellow and the blue deposit were mixed together. The following shows the composition of the mixture:—

Oxide of copper ..	(CuO)	7·75
Oxide of alumina ..	(Al_2O_3)	17·34
Oxide of iron ..	(Fe_2O_3)	1·43
Lime	(CuO)	2·58
Magnesia	(MgO)	1·66
Potash	(K_2O)	4·02
Soda	(Na_2O)	3·94
Sulphuric anhydride	(SO_3)	25·80
Chlorine	(Cl)	1·90
Fluorine	(F) ..	Small quantity
Silica	(SiO_2)	16·90
Water	(H_2O)	17·10
		100·42
Less oxygen equivalent to 1·9 Cl ..		0·42
		100·00

The substances present were thus much the same as in the previous case, but in different proportions. The chlorine present was exactly in the proportion required to combine with the iron to form ferric chloride, thus accounting for the yellow colour of one specimen; the blue colour, on the other hand, was due to sulphate of copper. After pointing out the difficulty of supposing that the presence of the above-named substances in the volcano could be explained by the introduction of sea-water, he went on to show how their presence might be accounted for. The alkalies would be derived from the lava itself, particularly from the more trachytic or felspathic sort, which is richer in alkalies and contains less of the ferruginous minerals. The alkaline silicates would be partly taken into solution by the interstitial water, which exists in all lavas while in the molten condition. Solution would be assisted by carbonic acid derived from the strata through which it ascended, and possibly also by a sulphur acid. The subsequent reaction of sulphuric acid upon the dissolved silicate or carbonate would account for the fact of its being found in the form of sulphate. The sulphuric acid he thought would be derived from sulphides of the metals iron, &c. For, though iron pyrites was easily decomposed by heat at ordinary pressures, there was reason to believe it could exist at a high temperature if subjected to great pressure, it being a common constituent of the crystalline as well as of the sedimentary rocks. When the metallic sulphides arrived at a part of the volcanic vent suitable for oxidation, they would lose their sulphur, which would be burned to sulphurous anhydride, and in the hot moist atmosphere of the cone would be further oxidised to sulphuric acid.

Mr. Anderson's paper was illustrated by numerous

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specimens of volcanic products, a number of which were collected in the year 1866 by Mr. Wünsch, a member of the Society, and by whom they were lent for the occasion.

An interesting discussion ensued, in the course of which Mr. Wünsch and Mr. Ogilvie gave some of their own observations made on Vesuvius, Etna, the Lipari Islands, &c. Mr. Tatlock, the President, and other gentlemen, also took part in the discussion. Some degree of surprise was expressed at the non-appearance of ammonium chloride in the results of Mr. Cochran's analysis, but that gentleman said he had purposely sought for it, and had failed to find any. In one of the deposits Mr. Anderson stated that Dr. Thorpe had found, by spectrum analysis, lithium in sensible quantity.

NOTICES OF BOOKS.

A Manual of Elementary Chemistry. By GEORGE FOWNES, F.R.S., late Professor of Practical Chemistry in University College, London. Eleventh Edition. Revised and corrected by HENRY WATTS, B.A., F.R.S. London: J. and A. Churchill. 1872.

OUR students will welcome this new edition of Fownes's "Manual." It is printed in bolder type, and contains many additions to the subject of organic chemistry, as this division of chemical science is generally treated in handbooks. Mr. Watts's name is sufficient recommendation that the most recently-established facts have been included in the work. There is, however, one objection to the enlarged form—the volume becomes rather too bulky. This indeed is the most serious fault to be found with the book. The edition is a valuable one, and students should hasten to procure a copy.

Notes for My Students.—Magnetism. By WILLIAM J. WILSON, F.C.S. London: J. Bale and Sons. 1872.

THIS is a valuable addition to the many handbooks for students in Physical Science. It will be useful to the candidate for examination, or will afford notes to the lecturer.

MISCELLANEOUS.

Analyst and Medical Officer of Health for Birmingham.—At a special meeting of the Birmingham Town Council held on the 17th inst., the Mayor presiding, the Sanitary Committee recommended that candidates for the two offices mentioned above be advertised for at the salaries of £150 and £500 respectively; an amendment was, however, proposed by Mr. Rolason that Dr. Alfred Hill, the present borough analyst, be appointed to the two offices at the salaries named. This was seconded by Dr. Barratt. The motion was unanimously adopted by the Council, and Dr. Hill was accordingly appointed Medical Officer of Health for the borough.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, December 16, 1872.

This number contains, in addition to several memoirs relating to astronomy, meteorology, physics, natural history, and mechanical sciences, the following original papers relating to chemistry:—

On a Meteorite which fell near Baudong (Java) December 10, 1871, presented to Musée d'Historie Naturelle at Paris, by His Excellency the Governor-General of the Netherlands' East Indies.—M. Daubrée.—It appears from this exhaustive account that several rather large-sized meteoric stones fell on the same day at or near the locality above mentioned. According to the analysis of Dr. Vlaanderen, the stone consisted percentically of:—Nickeliferous iron, 2·81; sulphuret of iron, 5·44; chrome iron, 4·41; peridote, 47·26; augite, 20·98; felspathic mineral; 17·0; total 97·90. 60·17 per cent of this stone is soluble in HCl. Its sp. gr. is =3·519.

Detection of Bromine and Iodine in Native Phosphates of Lime.—F. Kuhlmann.—This paper opens with a review on the geognosy of the native phosphatic minerals, and on the occurrence occasionally observed of iodine and bromine in small quantity in some of these (as, for instance, the phosphorite of Staffel, near Limburg-on-the-Lahn). Next the author calls attention to the fact that when the phosphatic minerals of the Lot, and of the Tarn and Garonne Départements are treated with sulphuric acid on the large scale, vapours of iodine are distinctly seen; but on a minute investigation of the minerals the quantity of iodine, accompanied by some bromine (a very minute trace), is found to be exceedingly small.

On some of the Derivatives from the Oxychlorides of Silicium.—L. Troost and P. Hautefeuille.—This memoir treats on the action of the oxychloride of silicium, $Si_8O_8Cl_8$, upon alcohol. By a rather complex process of operation there is obtained an ether,—

$$(C_4H_5O)_8Si_8O_{16}$$

a mobile clear liquid; sp. gr. at 0°=1·071; vapour density at 350° (boiling-point of mercury), 19·54. The ether is soluble in alcohol, and in ordinary ether, but not in water which gradually decomposes it, silica being precipitated. The authors next give an account of the action of ammonia on this ether, the result being the formation of an oily fluid, $(C_4H_5O)_7Si_8O_{15}NH_2$; but by prolonged action of ammonia upon the ether alluded to, several other compounds are formed.

New Method of Producing Ozone by Means of Charcoal (Gas-retort Graphite).—A. Boillot.—The description of a series of experiments whereby, the graphite being used as a conductor of electricity, pure and dry oxygen is slowly and partially converted into ozone.

Estimation of the Quantity of Oxygen Dissolved in Rain and Seine Waters.—A. Gérardin.—By Schützenberger's process (described in CHEMICAL NEWS, vol. xxvi, p. 204) the author has estimated the quantity of oxygen in rain-water which has fallen at various dates, from October 29 to December 8 last, and also in Seine water. The largest quantity of oxygen to the litre found in the former was found to amount to 8 c.c. per litre, in the latter to 6 c.c. The smallest quantity of oxygen in rain-water amounted to 2·59 c.c. to the litre; and in Seine water, to 3·33.

Journal für Gasbeleuchtung und Wasserversorgung, No. 20, 1872.

The original papers contained in this number strictly relate to matters pertaining to gas- and water-works engineering and management.

No. 21, 1872.

In addition to subjects specially relating to gas- and water-works engineering and management, we meet here with—

Analysis of the Water now Supplied to the Town of Wiesbaden.—Dr. R. Fresenius.—Hardness of the water between four and five. Composition in 1000 parts:—Sulphate of potassa, 0·0024; chloride of potassium, 0·0003; chloride of sodium, 0·0067; nitrate of soda, 0·0013; nitrate of lime, 0·0006; carbonate of lime, 0·0116; carbonate of magnesia, 0·0107; silica, 0·0081; organic matter (expressed by the quantity of oxygen required for its complete oxidation), 0·0007.

Water Supply to the Buildings of the Great International Exhibition to be held in Vienna in 1873.—T. Wieck.—The total quantity of water to be supplied for all purposes, inclusive of fountains, driving of machinery, &c., amounts to 1240 cubic metres per hour,—a quantity sufficient for a population of 200,000.

Bulletin de la l'Academie Imperiale des Sciences de St. Petersbourg, Vol. xvii., No. 5, 1872.

This number contains, in addition to original memoirs relating to other sciences, the following original memoir containing chemical information:—

Microscopical Investigation of the Sanative Mud met with in the Salt-Water Lakes Sak and Mainak, Crimea.—N. Jelesnow.—The mud of Sak was found to contain, by Goebel, in addition to some water, gases, and soluble salts, the following quantities per cent of other substances:—Organic matter, 2·7: sand found to contain—silica, 22·25 per cent; peroxide of iron, 7·24; alumina, 4·25; magnesia, 0·25 (this analysis was made in 1838). Hasshagen analysed the mud in 1849, and found, in addition to carbonate, phosphate, and sulphate of lime, the following constituents per cent:—Silica, 31·80; peroxide of iron, 9·52; alumina, 8·30; magnesia, 5·82; organic matter, 3·75. The mud of Lake Mainak and the water of that lake have been analysed by Major-General Iwanow, and found to contain respectively in 100 parts—the mud; carbonate of lime, 28·99; carbonate of magnesia, 3·69; chloride of sodium, 8·565; chloride of magnesium, 0·793; sulphate of lime, 3·79; sulphate of magnesia, 0·457; bromide of magnesium, a trace; sand and clay inclusive, 3 per cent; organic matter,

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20·81; water, 30·00. It appears that these muds are used medicinally as baths in some forms of gout and chronic rheumatism.

La Revue Scientifique de la France et de l'Etranger, December 14, 1872.

This number contains no papers relating to chemistry, but we call attention to the following memoirs:—

What we Gain by the Use of Manure in Agriculture.—G. Ville.—The continuation of the author's lectures on practical agriculture at Vincennes.

The Part Played by Glaciers in Geology.—A. De la Rive.

The Spectrum Exhibited by the Metalloids.—G. Salet.—An abstract of the author's inaugural dissertation read before the Faculty of Sciences at Paris.

Bayerisches Industrie und Gewerbe-Blatt, November, 1872.

This number contains no original papers relating to chemistry.

Bulletin de l'Academie Royale des Sciences, des Lettres et de Beaux Arts de Belgique, Nos. 9 and 10, Double Number, 1872.

This number contains no papers relating to chemistry.

American Journal of Pharmacy, December, 1872.

The original papers and essays contained in this number only relate to pharmaceutical sciences.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, November 21, 1872.

The Soap-boiling Industry at Dijon.—Sirandré and Co.—The detailed account of the methods of preparation of soap as carried on at the works of the parties referred to.

Similihuile, a Liquid to be Applied Instead of Linseed Oil. M. Petit.—It appears that the author has succeeded in preparing a liquid—the nature, composition, and mode of preparation of which is not specified—which while it possesses all the valuable qualities of linseed oil, does not, when mixed with pigments and applied to iron, wood, or other objects, become deteriorated by exposure to weather, and is not affected by heat as linseed oil is.

Moulin-Mercier.—Under this heading an account is given of an improved mill-work for grinding corn. The main advantages of this contrivance are,—that less motive power is required; that the millstones have to be less frequently burred; that the flour does not become heated, and that consequently a larger yield of flour as well as a better quality is obtained.

November 29, 1872.

Ceresine, a New Hydrocarbon which may be Employed as a Substitute for Bees'-Wax.—Ch. Mène.—It appears that ceresine is a by-product of the industrial process employed for purifying the native ozokerite met with in Austria, which is used for the purpose of obtaining paraffine. The crude ceresine is treated with sulphuric and sulphurous acids, and, lastly, with alkalies: the pure article is a white-coloured, semi-transparent, opaline body, void of taste and smell, fusing at from 61° to 63°, sp. gr. 0·880, insoluble in water, soluble in alcohol, not saponified by alkalies. Ceresine is used in Vienna instead of wax in some pharmaceutical preparations.

Description of a New Instrument for Taking Levels.—M. Bigot.—Illustrated by woodcuts.

Bibliography.—Under this heading the following work is quoted:—"La France Industrielle, ou Description des Industries Françaises," par M. P. Poiré, Professeur à l'Ecole Industrielle d'Amiens; 1 vol., 755 pp., 432 engravings; price 10 francs; Librairie Hachette, Paris. This work is highly spoken of, and is useful both for schools and for general reference.

Les Mondes, December 12, 1872.

Le Fondateur des Mondes et des Salles du Progrès.—Victor Fournel.—The article here reproduced from *Le Francais* is called attention to as containing some biographical particulars of the excellent and reverend editor of *Les Mondes*, who, according to the testimony of Dumas, as lately publicly stated by him in a meeting of the Academy of Sciences, "marche depuis près d'un demi-siècle à la tête du mouvement scientifique en France;" and who, next to the late A. Dumas, has written and edited more books than any one else in France.

Tachymètre.—P. Dupont.—Under this heading a short account is given of an instrument which appears to be devised for the purpose of rendering the teaching of geometry a rapid and pleasant course at schools; M. Lagout has given some lectures to prove this at Clermont-Ferrand, the result being that the *Maire* and the *Recteur* have decided that tachymetry shall be introduced into the schools under their control. The instrument is made in three different sizes, at the price respectively of 10, 21, and 100 francs; it is for sale at 41, Rue J. J. Rousseau, Paris.

Cause of the Blue Colour of the Sky.—M. Collas.—The author first refers to the blue colour exhibited by the pure water of certain lakes, and says that it is due to the therein dissolved or very minutely divided gelatinous silica, quoting as instances the lake of Genève, the water of the d'Huis, and more particularly the water of a source near to the Mont-Dore (Département du Puy-de-Dome), which water is even bluish-coloured when placed in a white glass decanter. The blue colour of the sky is referred by the author to the same cause, viz., very finely divided gelatinous silica (hydrated silica) kept in suspension in the clouds on account of its great lightness.

PATENTS.

Communicated by Messrs. VAUGHAN and SON, Patent Agents, 54, Chancery Lane, London, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

3160. W. T. Cooper, Oxford Street, Middlesex, "Improvements in preparing or making up medicated and other effervescing mixtures."—Petition recorded October 24, 1872.

3232. W. T. Cooper, Oxford Street, Middlesex, "An improvement in the manufacture of lozenges."—Petition recorded October 31, 1872.

3464. E. Hills, Warsash, Hampshire, and E. Biggs, Laurence Pountney Hill, London, "Improvements in deodorising and purifying sewage and other excrementitious matters, and in obtaining certain useful products therefrom."—Petition recorded November 20, 1872.

3477. P. Jensen, Chancery Lane, Middlesex, "Improvements in the manufacture of steel."—A communication from T. Brooks, Minerva, Stark, U.S.A.—Petition recorded November 21, 1872.

3628. C. Von Hennings, "The preparation of an extract from the berries of the mountain ash (Pyrus), (German, Eberesche)."—Petition recorded December 2, 1872.

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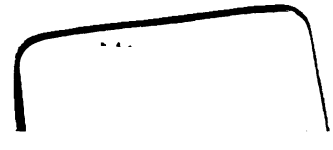

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